TOPICS OF THE MONTH

Fuel industries need chemical engineers

IN our September issue we had a number of articles touching on the part played by chemical engineering in the treatment of coal by carbonisation and other means. The importance of the chemical engineer's role in this field is confirmed in the Fifth Coal Science Lecture of the British Coal Utilisation Research Association, delivered in London recently by Prof. D. M. Newitt, F.R.S. Prof. Newitt, who is Courtaulds' Professor of Chemical Engineering in the Imperial College of Science and Technology, London, pointed out that the recent intensification of fundamental research into the physical structure and chemical constitution of coal is making call upon an increasing number of scientific disciplines and is leading to the introduction of more refined methods into nearly all branches of the fuel industries. In order to take full advantage of these improvements, the services of trained technologists are required to translate the findings of the laboratory into large-scale operations and to reduce the time lag which so often occurs at this stage of development.

In this connection Prof. Newitt judged the role of the chemical engineer to be of special importance, since he is primarily responsible for preparing mass and energy flowsheets and for solving the complex problems of scaling up. He gave one or two examples to illustrate the technique employed by the chemical engineer and cited the coal-water system, which appears in many guises in the fuel industries and which is involved in the processes of drainage, flotation, washing and granulating, playing a part also in the reactions associated with carbonisation and combustion.

The behaviour of water in particulate systems has been the subject of much research and, in the case of non-porous materials such as sand, the mechanism by which capillary, diffusional and gravitational forces control the movement of liquid and vapour in beds of the material is fairly well understood. Quantitative expressions for the rates of drainage and of drying of such beds can be derived on the basis of Poiseuille's treatment of capillary flow, and provide data upon which the design of de-watering and drying equipment can be rationalised. When applied to materials such as coal and coke, which are themselves porous, however, modifications to the simple theory are necessary. The moisture distribution and the rates of drainage and drying are significantly affected by the porosity of the material, and there is evidence that in the case of very fine pores the abnormal physical properties of the adsorbed water exert an influence on water movement.

In conclusion, Prof. Newitt stressed the importance of understanding the detailed mechanisms of mass and heat transfer as a prerequisite for designing plant in which inter-related changes of physical state and chemical composition are to take place.

Get the sun working

SOME practical advances towards the industrial use of solar energy have been made in recent years and, in the situation in which the world finds itself, it could certainly do with this promising extra source of energy. Is it not time some country did the same with solar energy as Britain has done with the atom, and went ahead with it in spite of the obstacles? This applies particularly to non-industrialised countries which find other sources of energy hard to obtain and, as it happens, these countries are often blessed with an abundance of sunshine.

As an example of what can be achieved, a small solar energy plant has been developed in Russia which can produce over a gallon and a quarter of boiling water an hour, distill about the same amount of sea water in 24 hr. and cook a dinner for a family of five. The sun's rays are concentrated by a concave aluminium mirror less than 4 ft. in diameter; larger installations of the same type, but with high-precision mirrors could produce temperatures up to 3,000°C. to produce steam or even to melt metals or bake ceramics.

A description of this plant was given to an international symposium in New Delhi, arranged by the Unesco Advisory Committee on Arid Zone Research and published recently in book form by H.M.S.O. (' Wind and Solar Energy,' 35s.). New types of solar energy concentrators described at this symposium by Mr. A. L. Gardner, Unesco Adviser at the Indian National Scientific Documentation Centre, are capable of immediate practical application by many industries and domestic users where energy in the form of heat is required. For application to such purposes the need nowadays is not for research, says Mr. Gardner, but for development and manufacture.

An important scientific use of solar energy at present is in the study of materials at very high temperatures using solar furnaces. New advances in this field should come to light at a two-day symposium which is being held from January 21 to 22 at Phoenix, Arizona, and which is organised by the Association for Applied Solar Energy in conjunction with research and scholastic bodies.

Australian plastics progress

THE new Tasmanian sulphate of ammonia plant described in this issue is just another example of the way they are forging ahead " down under " and heading towards self-sufficiency in raw materials. The chemical industry naturally figures prominently in these developments.

As for plastics, we find here a record of expansion in the last 10 years that is probably unbeatable in Australia. A recent estimate puts the 1956 value of

plastics produced in Australia at over £26 million, amounting to some 13,000 tons. Such a production represents more than 50% of Australian plastics requirements. New projects will continue to reduce dependence on imported raw materials.

Generally speaking, as the Australian *Financial Review* points out, it is not feasible to manufacture and process plastics in Australia at world prices. This is because of the small local market and the large scale on which chemical manufacture must often be based to secure economic output.

Atomic energy chief praises chemical plant manufacturers

PRAISE for the way in which the chemical plant industry has responded to the severe technological demands of the atomic energy field was expressed by Sir John Cockcroft, F.R.S., director of the Atomic Energy Research Establishment at Harwell, recently. Speaking at the annual dinner of the British Chemical Plant Manufacturers' Association, he pointed out that, for atomic energy projects, the quality of the plant needs to be high. Newcomers to this field often find that normal commercial standards of construction welding and inspection are quite inadequate. The industry has shown that the necessary high standards can be achieved.

Some hint of the big opportunities for the chemical plant manufacturing industry in the field of uranium extraction is given by the fact that, in the future, the amount of uranium ore to be processed in the United States alone will rise from 3 to 6 million tons p.a. and that by the time the present projects are completed the annual production of uranium oxide in the free world will reach 30,000 tons. Sir John pointed out the example of the South African uranium extraction plants, on which some £60 million was spent. Even larger capital expenditure will have to be made in future, especially in countries like Canada, which is certainly the El Dorado of the uranium mining industry of the future.

In the field of basic atomic energy materials, the demand for super-pure reactor-grade graphite grows rapidly with time, whilst exotic materials such as beryllium, niobium and zirconium are demanded in tens of tons, when a decade ago they existed in tens of grammes only. Also, the atomic energy industry is still interested in finding a really cheap process for production of heavy water—at a cost even lower than the present U.S. cost.

Many of the lessons learnt in building plant for atomic energy and the processes and technology used have their applications in fields outside atomic energy. Examples are the use of gas bearings in circulating pumps and the use of pulsed columns for extraction processes. This was an additional reason for chemical plant manufacturers to take an active part in atomic energy work, Sir John pointed out.

It is an encouraging sign of the healthy state of chemical engineering in Britain that Sir John Cockcroft, director of an organisation which employs a great many chemical engineers, should pay tribute to the work of those in the plant manufacturing industry. For proof of the great incentive which has been provided by atomic energy needs one need only take one example which was provided by Mr. G. N. Hodson, M.B.E., chairman of the B.C.P.M.A., in proposing a toast at the dinner. This was that the pressure vessels which surround the reactors at Calder Hall were once thought to be the largest which, under all the circumstances, could be built; now, it was understood, the building of much bigger and thicker vessels is envisaged.

Mr. Hodson referred to the emergence of the complete chemical plant contractor and to the wealth of experience and 'know how' that had been acquired by the industry. As an example of overseas awareness of this competence he cited the recent award, by an American firm, of a contract for £3½ million to a B.C.P.M.A. member.

A 210-ton reactor vessel for Canada

AN example of the hefty, as well as tricky, work that is carried out by plant fabricators for atomic energy projects is provided by the reactor vessel for Canada's first nuclear power plant. The vessel is approximately 12 ft. in diameter and 35 ft. high. It is designed for a pressure of 1,200 p.s.i. and is 5-in. thick, increasing in places to 6½ in. It weighs 210 tons, of which 70 tons is in the head. The latter is bolted on, since it has to be demountable, allowing full-way access into the vessel. The head contains numerous smaller openings, each with its own closure. Extreme pressure tightness is called for, because the vessel will contain very costly heavy water.

The order for the construction of the vessel went to the British firm of Babcock & Wilcox Ltd., who are at present carrying out this work at their Renfrew, Scotland, works. The Canadian reactor will be the first nuclear power plant in the Commonwealth other than in Britain.

New chemical plant material

A NUMBER of industrial applications of *Fortiflex*, a chemical compound of natural rubber with phenolic resin, was reported in the autumn issue of *Rubber Developments*. According to Mr. P. D. Patterson, of the Dunlop research centre, the material is immune to rusting and other atmospheric corrosion. Resistance to acid is generally good, but naturally depends upon the kind and concentration of the acid.

Containers for various industrial purposes have been produced and tried out, while, in the chemical field, the material has been used in cyclone driers. During the manufacture of ammonium nitrate and nitro chalk, metal-bodied driers frequently become clogged and cause production delays while the apparatus is cleaned. It is stated that *Fortiflex* containers, owing to their flexibility, avoid this and are also corrosion resistant and long-wearing.

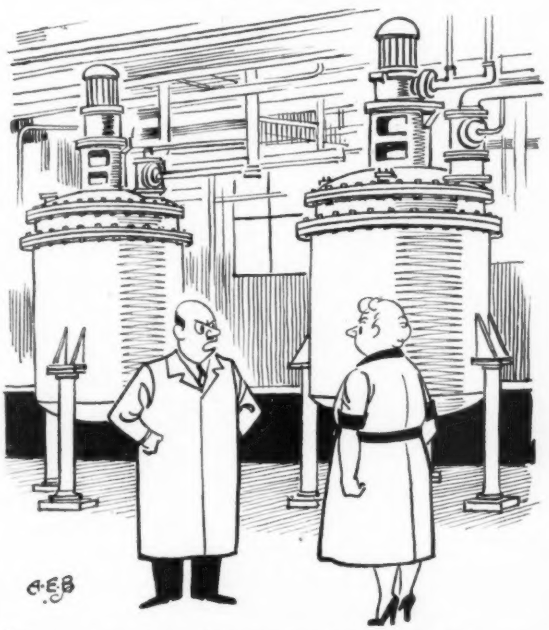
Another promising development is the use of *Fortiflex* containers in electroplating, the products including pickling crates, acid pickling buckets, coppering tanks and tumbling barrels.

Glass heat exchanger

An ingenious design of shell and tube heat exchanger, which is completely impervious to corrosion, has been constructed by the American Corning glassworks from a new type of *Pyrex* glass. This heat exchanger has been tested for more than a year—it has a capacity of 50 sq. ft.—and proved to be highly successful. The main body of the unit is of standard 6-in. *Pyrex* glass pipe, while the 26 tubes are lengths of $\frac{3}{4}$-in. thin-walled *Pyrex* tubing supported every 6 in. by baffle plates. The header assembly of *Teflon* and high-alumina ceramic is held in place by a *Monel* retainer ring and steel flanges and springs coated with epoxy resin. The modular section can be mounted either horizontally or vertically in any combination of series and/or parallel flow, enabling optimum heat transfer and pressure drop. Operating temperatures up to 375°F. are possible on the shell side and 200°F. on the tube side, while operating pressures can be as high as 20 p.s.i.

The new heat exchanger can be used as a condenser, a cooler or a heat interchanger. The big advantage is that the operator can see at a glance if conduction-impairing scale or algae have been built up by impure cooling water. The tubing can be cleaned by recirculating a dilute solution of hydrochloric acid. As all components in contact with the fluids are highly corrosion resistant, the need for replacements is very much minimised.

Comical Engineering Situations



"FESTIVE SEASON OR NO, MRS. PEABODY, I'M AFRAID YOU CAN NOT USE ONE OF OUR MIXERS FOR THE CANTEEN CHRISTMAS PUDDING"

Plastics project for Scotland

Grangemouth, Scotland, now becomes established as a centre for styrene monomer production, the subject of an article on another page. A new project that has now been earmarked for this area will add still further to Grangemouth's importance as a chemical industry centre and as the main scene of chemical engineering activity in Scotland. This is the new polythene project of British Hydrocarbon Chemicals, which envisages a plant with an annual capacity of 11,000 tons. It will be the first plant in Britain to use the low-pressure process for polythene production developed by the Phillips Petroleum Co. of America.

Sulphur mine at sea

The first completely offshore sulphur mining operation in history will be undertaken by Freeport Sulphur Co. at a deposit discovered in the Gulf of Mexico by Humble Oil & Refining Co. The deposit, located off Louisiana in 45 ft. of water six miles from the nearest land, represents a major new source of sulphur, according to a joint announcement by the two companies.

Freeport will design, install and operate a mining plant to produce sulphur by the Frasch hot-water process. Construction is required to begin by the latter part of 1958 and is expected to take two years to complete.

The deposit, known as Grand Isle—Block 18, was discovered by Humble in the course of offshore oil exploration. The sulphur was found some 1,700 ft. below the floor of the Gulf in the caprock of a salt dome, a geological formation commonly found in the Texas and Louisiana Gulf coastal area.

Freeport has developed and successfully operated three sulphur mines in the coastal marshes. Two of the mining plants were erected on 75- to 95-ft. piling, and the third was built on a barge, floated to the site and sunk in place. The company also pioneered the use of sea water in the Frasch process and marine transportation of sulphur in molten form, innovations which will greatly facilitate offshore operation.

Production of sulphur from beneath the floor of the Gulf will be entirely different from production of oil. The Frasch process, whereby superheated water must be fed continuously into the formation to melt the sulphur, which in molten form is forced to the surface through wells, requires a heating plant of great capacity and weight. This plant and all other installations will have to be built on a tall, steel structure, out of reach of storm waves. The structure will be the largest of any of the permanent structures in the Gulf of Mexico.

In the absence of storage space, insulated barges will shuttle the sulphur in molten form to Port Sulphur, storage and shipping point about 25 miles away. On the return trip, the barges will haul fresh water necessary for boiler make-up and auxiliary services. The Gulf itself, however, will supply the millions of gallons of water required daily for injection into the wells at high temperature.

Titanium comes to the pulp and paper industry . . .

SUCCESSFUL use of titanium as a material of construction for an important item of equipment in the paper industry—a chlorine dioxide mixer—has been reported in the United States. The mixer, lined with *Rem-Cru* A-70 titanium, was examined after five months' service at the Acme, North Carolina, plant of the Riegel Paper Co. and found to be free from corrosion damage.

ClO_2 is coming into increasing use by the pulp and paper industry. The trouble is, though, that the usual corrosion-resisting materials are rapidly attacked by this strong bleaching agent. Stainless steels are subject to severe localised pitting, especially under the conditions of the abrasive wood pulp slurry. Special chrome-nickel-molybdenum alloys extend the service of equipment, but even with these metals a mixer's life expectancy is rated at one year, with intermediate repairs the rule rather than the exception, because of stress-corrosion cracking.

The mixer used by the Riegel Paper Co. was designed and built by the Improved Machinery Co., of Nashua, New Hampshire, and was given a titanium lining in the barrel of the mixer, where abrasion and pitting corrosion are most severe. Upon examination, the ends of the mixer, which were a high chrome-nickel-molybdenum alloy, showed the usual visible corrosion, while the titanium lining in the centre was completely free from pitting, and no measurable corrosion had occurred. On the basis of examination, this mixer should last several years longer than any previous chlorine dioxide unit.

Titanium's corrosion resistance to the chloride ion has been recognised since early exposures to sea water showed remarkable resistance to attack. Tests in moist chlorine, sodium and calcium hypochlorite solutions, and a variety of hot metallic chloride solutions, rounded out the picture of the metal's potentialities.

Small parts (baffles, plates, nozzles, etc.) had been used successfully by the paper industry earlier, but this seems to be the first major piece of titanium equipment in the pulp and paper field.

. . . and so does the 'Kollermill'

A SIMPLE but effective machine which has played a prominent role in the development of a new, continuous, cold soda hardwood pulping process in the United States seems destined for wider use in industry. The Haug *Kollermill* is a new, continuously operating version of the *Kollergang*—a grinding device which has been used in the pulp industry for some years.

In the newer machine the essential components are a roll, a cylinder and a screw conveyor. The roll, which is of considerably less diameter than the cylinder, is mounted inside the cylinder in such a way that the chips, as they are carried round inside the rotating cylinder, pass through a small gap between the cylinder and the roll, where the pressing action takes place. The relative speed of cylinder and roll can be varied and in one version of the *Kollermill* the pressure of cylinder against roll is adjustable from relatively light to very heavy.

The continuous, cold-soda pulping method was developed at the forest products laboratory of the U.S. Department of Agriculture using eight different types of hardwood. Corrugated boards produced by the new method emerged well from usual tests. Used in place of hammer mills for fiberising the knotty 'rejects' from kraft and sulphite pulp mills, the *Kollermill* gave some surprisingly good results.

This machine is made in several sizes, including a very small machine for laboratory use. From research carried on with one of the laboratory *Kollermills* at the University of New Hampshire it is apparent that this machine will find employment in many other industries besides that of paper making. It is understood that the University has obtained very interesting results with the machine for the reduction of peat moss, carbon and many other materials.

Carbons, crucibles and curiosity

'HAS it ever occurred to you,' said one research worker to another after lunch on a sultry day in June 1930, 'that from now until nearly midnight several thousand cinemas are burning carbon arcs continuously?'

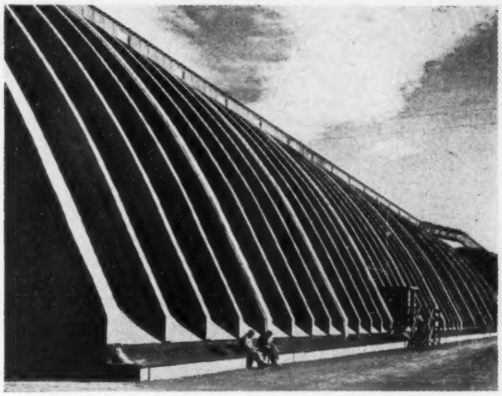
This casual remark triggered off a chain reaction of excited activity at the Battersea, London, works of the Morgan Crucible Co. Ltd., to which the two research workers belonged. Test equipment was constructed, accompanied by a market survey; Battersea's first honorary chief cinema operator spent a few weeks in hospital as a result of the combined effect of poor ventilation and the combustion of the first carbons. In a few years, bitter experience and patience brought happier results. A range of carbons suitable for many of the projectors then in use was produced and a few were sold, chiefly for experimental purposes.

This eposide is typical of the spirit and enterprise of this firm, if not of the leisurely prose, touched with delightful humour, in which its foundation and subsequent growth are recorded in a history book produced by Morgan's. This splendidly produced work covers the hundred years since 1856 when five Morgan brothers turned from merely selling crucibles to manufacturing them in a small factory which they set up at Battersea. The factory grew as the firm expanded to embrace a wider range of products including refractory and carbon specialities.

With a modesty typical of this remarkable firm, the chairman, Mr. P. Lindsay, O.B.E., M.C., says in a prologue: 'In achieving our purpose, the author most certainly has not "hidden our light"; indeed, we feel he has let it shine too brightly. . . . The thread of romance runs through the pattern of all industrial enterprise, but it needs to be coloured to be recognised.' This fascinating story of a company whose function and boundaries are so hard to define, but whose products are so universally necessary, hardly needs colouring.

Sulphate of Ammonia for Australia

New plant at Risdon, Tasmania, will eventually meet all Australia's needs

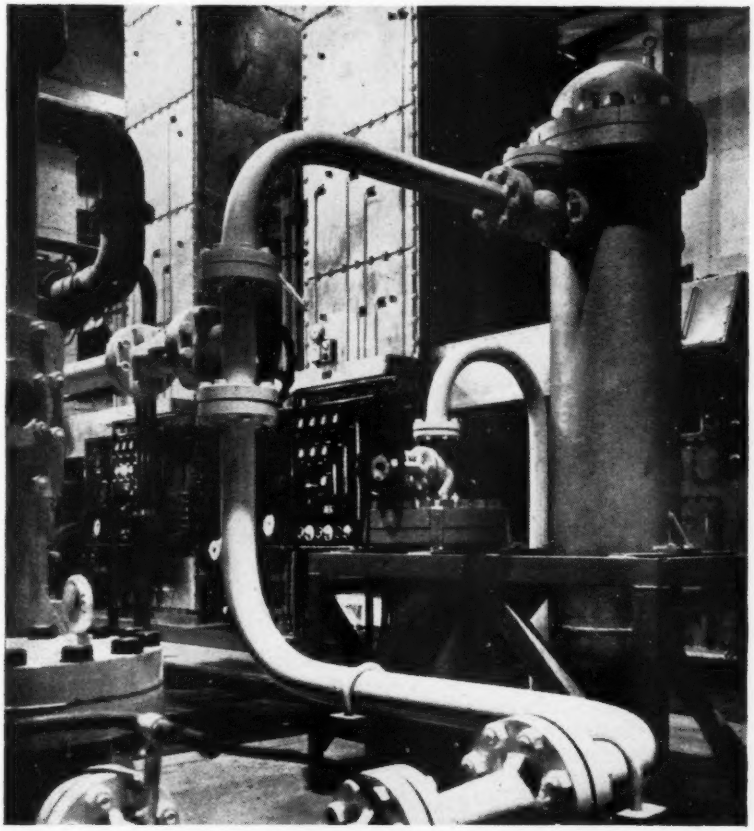


Storage silo at Risdon will hold 25,000 tons.

A NEW plant for the production of 55,000 tons p.a. of sulphate of ammonia—sufficient to supply more than half of Australia's requirements, came into operation recently at the Risdon, Tasmania, factory of the Electrolytic Zinc Company of Australasia Ltd. At the official opening of the plant on November 1, Mr. H. T. Hey, chairman and managing director of the company, said plans were being made to raise annual production to 155,000 tons, but it is too early yet to reveal details. Most of the initial output will go to Queensland and New South Wales.

The manufacture of sulphate of ammonia is only one phase of the company's activities in Tasmania, which include, at Rosebery, the production of concentrates of zinc, lead and copper from ore mined in the locality, while at Risdon, the works are equipped to produce high-grade electrolytic zinc (105,000 tons p.a.), zinc diecasting alloy, zinc dust, zinc sulphate, cadmium, cobalt oxide, sulphuric acid (130,000 tons p.a.) and superphosphate (150,000 tons p.a.)

> ★ **Zinc concentrate — the raw material treated at Risdon—contains 3 tons of sulphur for every 5 tons of zinc. No wonder Electrolytic Zinc has given a lot of thought to ways of using up this sulphur.**
>
> ★ **The Risdon sulphate of ammonia plant could be expanded to three times its initial size if necessary.**
>
> ★ **Total power requirement for the fertiliser plant is over 30,000 h.p. (22,500 kw.).**
>
> ★ **Built at a cost of £4 million, the plant employs only 20 men. Altogether, Electrolytic Zinc's operations in Tasmania provide direct employment for about 3,400 men.**



Air separation units.

The raw materials for sulphate of ammonia production are sulphuric acid and ammonia, the latter being prepared from a mixture of hydrogen and nitrogen. Cheap power is available from the Tasmanian Hydro-Electric Commission, to complete the attractive conditions for this operation, while a further advantage is that the plant stands near the mouth of a river and has deep-water facilities.

The process

The Risdon process involves the production of ammonia by synthesis from hydrogen, produced by the electrolysis of water, and nitrogen. The by-product oxygen from both

these sources is formed by the direct neutralisation of sulphuric acid by gaseous ammonia.

The process may be conveniently divided into five distinct operations, as follows.

Sulphuric acid

Sulphur dioxide gas, evolved from the roasting of zinc in suspension or flash roasters in the zinc plant, is first cooled in waste heat boilers where steam is produced for use in other sections of the works. The gas is then drawn through cyclones and hot Cottrell electrostatic precipitators for collection of zinc calcine dust. The roaster gas which contains about 7% sulphur dioxide by volume passes through flues to the contact acid division. Here it is further cleaned, dried and converted to sulphur tri-

Conversion section.

oxide for absorption to 98% strength sulphuric.

Nitrogen and hydrogen

Nitrogen is obtained from air by liquefaction and fractional distillation, while hydrogen is produced by the electrolysis of water in two batteries of Trail-type cells, each battery having 336 cells in 8 rows of 42. Normal production of hydrogen is 2,200 cu.ft./min.

Ammonia production

Hydrogen and nitrogen are mixed in the proportion 3 : 1 by volume and purified to remove traces of oxygen. This purification is carried out by passing the gases over a nickel catalyst at 350°C. The purified gases are then compressed to 361 atm. (5,300 p.s.i) in high-pressure, six-stage compressors, driven by 1,200-h.p. electric motors, before being delivered to the synthesis section.

In this section, the gases are circulated through a converter containing an iron oxide catalyst, where a proportion is synthesised to ammonia, which is condensed by cooling and collected in a catch-pot. The remaining unconverted hydro-nitrogen gas, together with some uncondensed ammonia, is re-circulated together with fresh 'make-up' gas, and refrigerated for further condensation of ammonia in another catch-pot. The unconverted hydrogen-nitrogen gas is passed through the converter system again.

The liquid ammonia formed in the synthesis section is freed from hydrogen and nitrogen dissolved in it, and is finally gasified for use in the production of sulphate of ammonia.

Production of sulphate of ammonia

Ammonium sulphate is produced by the interaction of gaseous ammona and 98.6% sulphuric acid. Gaseous ammonia and sulphuric acid are fed to saturators in which the reaction takes place. A slurry of ammonium sulphate crystals is formed in the saturators and is passed to centrifuges where the crystals are separated from the mother liquor. The crystals are washed with hot water in the centrifuges to reduce the acidity of the final product.

The wet sulphate of ammonia crystals are then freed from moisture in a Royston drier by means of heated air. Hot crystals from the drier are delivered to a rotary cooler. Atmospheric air is drawn through the cooler counter-current to the salt flow to cool the dry crystals. Sulphate of ammonia from the cooler passes by means of belt conveyors to a storage silo.

The concrete silo is rectangular in plan and of parabolic arch form in cross section. It has capacity for 25,000 tons of sulphate of ammonia.

Ammonium sulphate is reclaimed from the silo by means of a travelling scraper which directs the sulphate through holes along the longitudinal centre line of the silo floor to a belt conveyor in the subway. It is then conveyed to the bagging station on the wharf. Here it is first screened and the oversize crushed. Finally, the sulphate of ammonia crystals are weighed and bagged for despatch.

A Handy Nomogram for:

By D. S. Davis

(Professor of Engineering, University of Alabama)

RELIABLE data[2] on the total pressure, solubility and temperature of aqueous solutions of sulphur dioxide have been successfully correlated by means of the equation:

$$\log. P_m = a + b \log. P_w$$

where P_m = total pressure, sulphur dioxide and water vapour, millimetres of mercury; P_w = vapour pressure of pure water at the same temperature, millimetres of mercury; and a and b depend upon the concentration of the solute.

The accompanying line co-ordinate chart shown on the opposite page, which was constructed through application of well-known methods,[1] extends considerably the utility of the original data. The use of the chart is illustrated as follows:

What is the solubility of sulphur dioxide in water at 30°C. when the total pressure is 350 mm. of mercury? Follow the broken line; connect 30 on the temperature scale and 350 on the total pressure scale with a straight line and note the intersection with the curved solubility scale at 3.5 g. of sulphur dioxide per 100 g. of water.

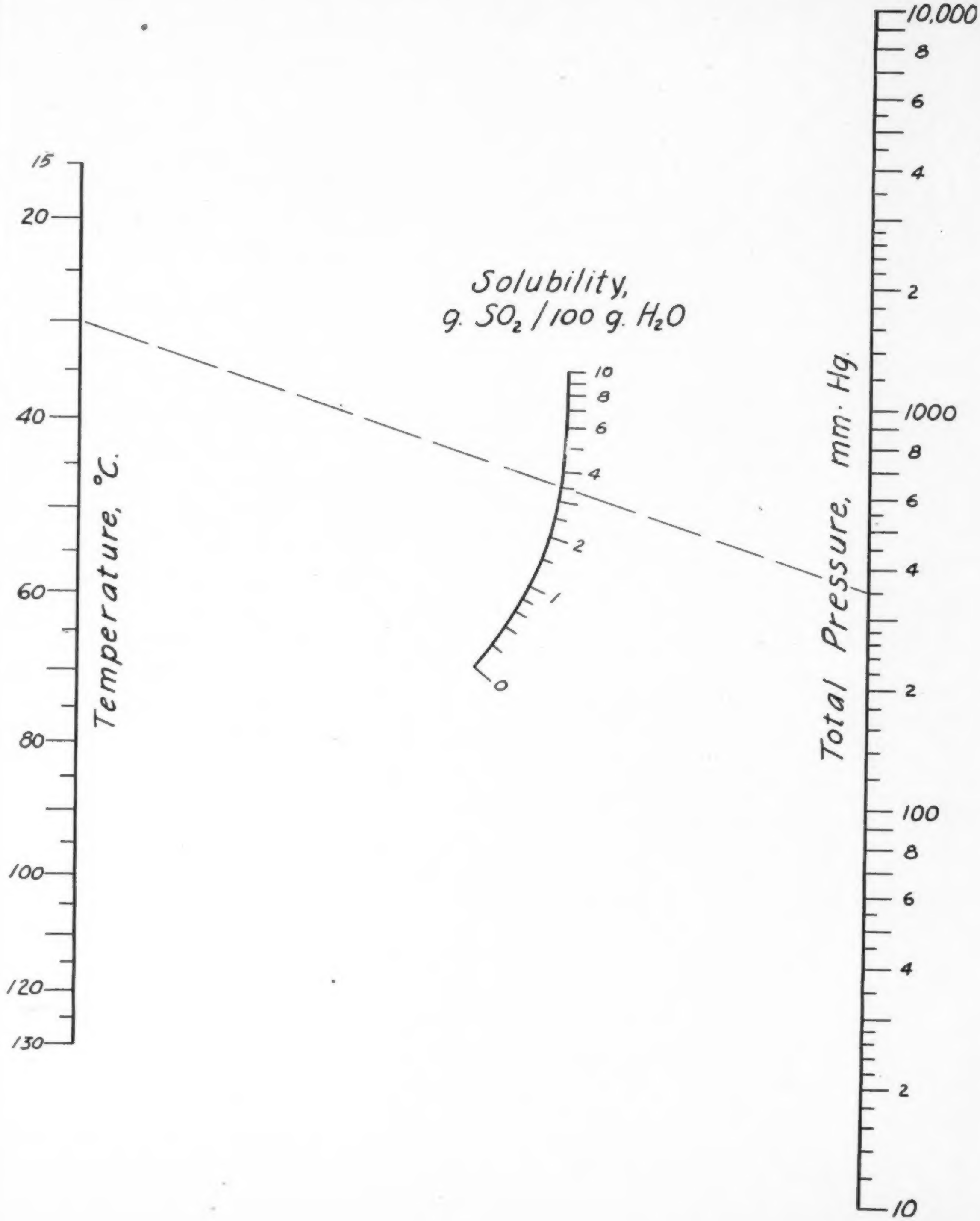
At 60°C. what is the total pressure over an aqueous solution of sulphur dioxide that contains 2 g. of sulphur dioxide per 100 g. of water? Connect 60 on the temperature scale and 2 on the solubility scale with a straight line (not shown) and note the intersection with the total pressure scale at 600 mm. of mercury.

REFERENCES

[1]D. S. Davis, 'Nomography and Empirical Equations,' chapter 10. New York, Reinhold Publishing Corporation, 1955.

[2]A. W. Plummer, *Chem. Eng. Progress*, 1950, **46**, 369.

Solubility of Sulphur Dioxide



The Manufacture and Uses of MINERAL WOOL

By A. E. Williams, Ph.D., F.C.S.

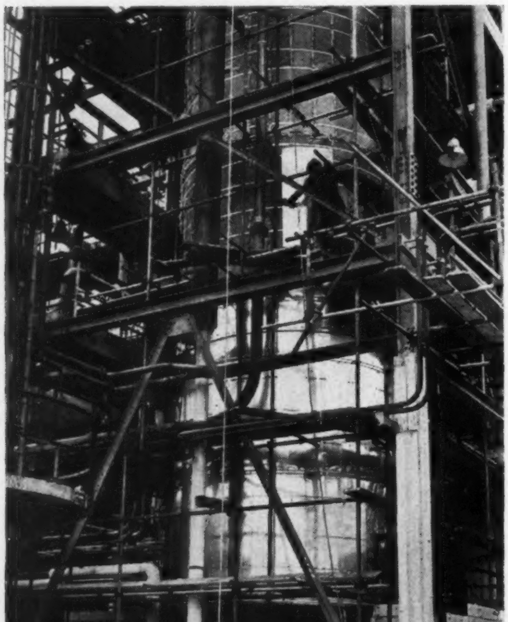
MINERAL wool, or rock wool, is an entirely inorganic, fibrous material produced from a variety of substances such as dolomite, clay, limestone, sandstone, slate waste, furnace slags and other by-products. Essential ingredients of the raw material are oxides of silicon, calcium, aluminium, magnesium and iron. There is thus a great variety of minerals that are suitable for mineral wool production and, in general, these minerals are of little value for any other purpose. Consequently, mineral wool is one of the few manufactured products for which the raw material is obtained very cheaply.

To offset this economic advantage, however, processing costs tend to be high, for to convert such minerals to wool a great deal of heat has to be expended, while the plant used has to be capable of withstanding both high temperatures and corrosive influences. It is estimated that to produce 1 ton of wool requires an expenditure of about 7 cwt. of coal or other fuel of equivalent heating value.

Manufacturing technique

The exact method of processing the minerals to produce the wool varies slightly with the varieties of minerals employed and, to obtain a wool of the required composition and physical properties, very often more than one mineral is used. In all cases, however, it is necessary to reduce the minerals to powder form with suitable grinding machinery; in some instances the mineral powder has to be dried. A considerable saving is sometimes effected by the use of iron blast furnace slag or other slag, for in these cases the unwanted moisture and volatile matter has already been expelled. Types of furnace employed to melt the minerals include both the ordinary type of cupola and also electric induction furnaces.

When the batch in the furnace has reached the molten state—which may require a temperature of 2,600°F. or more—it is poured at a carefully controlled rate, in the form of a vertical stream, before a blast of steam or air. This blast first breaks up the molten material into globules, some of which become elongated into the form of fibres. The whole of this material is blown by the blast into a sheet-metal chamber, the side opposite the blast nozzles being made of stout gauze which allows the steam to escape but traps the fibre and unconverted globules. The latter are termed 'shot' and this material appears in two varieties, that which is entangled and firmly adhering to the fibre or wool, and the larger globules which fall to the floor of the collecting chamber and so can easily be separated. The value of the mineral wool is ascertained to some extent by the proportion of 'shot' it contains; the greater the proportion of shot the lower the value.



[*William Kenyon & Sons Ltd.*

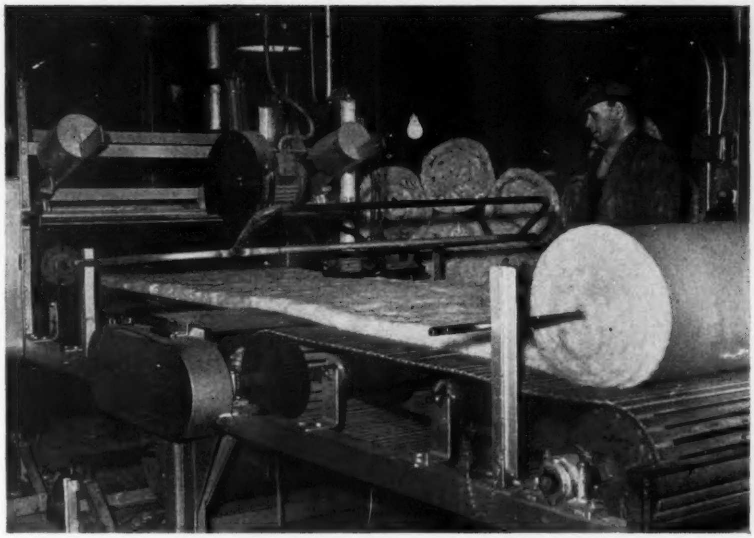
Two-stage distillation unit insulated with mineral wool and covered with aluminium sheet.

Testing for 'shot' content

It follows that an important test in the mineral wool factory is the determination of shot content of the wool. In one test of this type the wool is screened on a 50-mesh screen until the fibre portion has passed through. The quantity of non-fibrous material remaining on the screen is reckoned as shot. This method is not very satisfactory, because shot of very small diameter will remain with the fibre and pass through the screen, so that the amount of fibre recovered and recorded as such is too high.

An improved method has been devised by the U.S. Bureau of Mines, wherein the average fibre size of the wool is determined and then the wool is pulverised without destroying the small shot. This may be done by using a hydraulic pressure of about 2,000 p.s.i. After pulverising, the

fibre is placed in a hydraulic classifier and the velocity of the ascending water column may be altered according to the fibre size of the wool. The fibres are eliminated with the overflow of the water, while the shot remains in the bottom of the classifier; the shot may then be dried and weighed and its proportion in the original wool ascertained.



'Rocksil' insulation material in the course of production.

Mineral wool in Britain

A typical British-made mineral wool is *Rocksil*, produced in Stirling, Scotland, from a mixture of dolomite and siliceous clay. The raw minerals are first crushed and then led to a furnace in which they melt. A stream of the molten mineral from the furnace is next treated with a powerful steam blast and the resulting wool falls down a chute to the floor below, from whence it is made up into rolls interleaved with paper. One variety is termed 'loose wool,' while another is made up into the form of quilts of black bitumen paper filled with the mineral wool.

Another British mineral wool is *Stillite*, made from a mixture of rock and slag at Stillington, Co. Durham. From the slate waste accumulated at the quarries in north Wales a mineral wool has been produced and machinery has been installed with the object of eliminating the bulk of the shot. It is a characteristic of the slate industry that for every ton of useful slate produced there is at least ten times the quantity of waste material. So that the development of a slate-wool industry is advantageous in that it will gradually use up the accumulations of waste material.

Thoughtful application of chemical engineering knowledge helps in the manufacture of mineral wool; in return, this material makes itself useful in the insulation of pipes and distillation columns, in filtration, and as a sound deadener.

American progress

The manufacture of mineral wool had its origin in the U.S.A., and over 50 years ago this product was being made from limestone found in the State of Indiana. Much experimental work on the subject has been carried out in the U.S., and the range of materials available for its manufacture has been greatly extended; at the moment the American output is over half a million short tons p.a.

The U.S. Bureau of Mines has made tests with mixtures of granite, marl and limestone. These tests show that 40% granite and 60% limestone give satisfactory mineral wools, while suitable wool is also produced from 40% granite and 60% marl.

In one test, a mixture of 40% granite and 60% marl was melted and blown into wool at a temperature of 2,620°F., at a rate of pour of 1.13 lb./min. Steam was supplied through a vee nozzle at 50 p.s.i. gauge pressure. The finished wool had a fibre diameter of 7 microns and consisted of 61.7% fibre and 38.3% shot.

In another experiment, limestone was substituted for the marl; this mixture was heated to 2,650°F. and was poured from the furnace at the rate of 1.92 lb./min. The stream temperature was about 100°F. lower than the temperature of the melt in the crucible. Steam pressure and nozzle were the same as before, and the wool produced had an average fibre diameter of 7 microns, and contained 62.4% fibre and 37.6% shot.

Thermal insulation

The British mineral wool *Rocksil* has a fibre diameter of approximately 10 microns and a fibre length of about 2 in., and in the spaces between the felted fibres there are numerous air spaces which provide an efficient insulating medium. This material consists of about 96% of air by volume, so that conduction within the product is negligible. The thermal conductivity of an insulating medium offers an important basis upon which relative value may be judged, and at normal temperatures the thermal conductivity of this wool is about 10% lower than that of efficient heat-insulating materials in common use. At higher temperatures the advantage of the mineral wool is more apparent, since the thermal conductivity of the wool increases relatively more slowly with increase of temperature compared with older insulating materials. The higher the working temperature, the greater becomes the advantage of mineral-wool insulation; the latter can readily withstand temperatures up to 1,400°F. by direct contact.

For the insulation of superheated steam pipes, in which the surface to be insulated may have a temperature between 900 and 1,250°F., the use of the material is particularly advantageous, since there is no need to provide protection from high temperatures by an undercoating, or 'barrier' insulation, which of necessity has a relatively higher thermal conductivity. The fact that the mineral wool can be used in direct contact at temperatures up to 1,400°F. confers a double advantage, for not only is it more expensive to have to apply two layers, but the high conductivity of the 'barrier' layer means that a

greater overall thickness of insulation has to be applied to achieve the desired insulating effect.

The dual effect of low thermal conductivity and lower cost of application, especially for high-temperature work, means that for a given capital outlay a high plant efficiency can be obtained with mineral wool of this kind. The thermal conductivity of this type of mineral wool (B.Th.U./sq.ft./hr./°F./1 in. thickness) ranges between 0.24 and 0.26.

Apart from insulation for pipes and plant in industry, mineral wool is also largely applied to the insulation of buildings, over ceiling joists, or applied during construction under floor boards, in walls, etc.

In addition to mineral wool mats and quilts, there is now a *Rocksil* acoustic blanket, consisting of felted mineral-wool fibres backed on both sides with flameproof scrim cloth, stitched at intervals, both edges being enclosed. This blanket material has a density of only 4 lb./cu.ft. and is used for sound absorption, usually behind panels.

Sewn sheets are also available consisting of felted fibres machine-sewn between scrim cloth, using very fine stitching wire. The result is a resilient quilt coupled with great mechanical flexibility, and it is used in the insulation of pipes, bends, ducts and other units of plant. Sewn sheets can be cut on site to the required dimensions to fit exactly and snugly to the circumference of a pipe. They are particularly effective for traced pipes where maximum heat exchange can be obtained with no possibility of heat leakage. The optimum thickness of *Rocksil* to use for a particular pipe-insulating problem can be seen from Table 1, which gives heat losses in B.Th.U./lin. ft./hr. for a 6-in.-bore pipe.

Where a flat surface has to be insulated, Table 2 is useful. This gives heat losses in B.Th.U./sq.ft./hr. from flat surfaces insulated with different thicknesses of *Rocksil*.

Rocksil insulation has been applied to the distillation columns in some of the new oil refineries recently erected in Britain. Since most of these units are in exposed positions, the mineral-wool insulation is protected by sheet-metal covering such as aluminium sheet. This metal sheeting can be applied with equal efficiency to pipes, bends, flanges and other unusual shapes.

Table 1. Guide to Thickness of 'Rocksil' for Different Pipe Insulating Problems

Pipe temperature, °F.	Rocksil *thickness*				
	$1\frac{1}{2}$ *in.*	2 *in.*	$2\frac{1}{2}$ *in.*	3 *in.*	4 *in.*
200	47.9	40.1	33.7	28.9	24.6
300	94.0	79.8	68.3	63.8	47.9
400	152.7	130.0	110.4	97.5	81.3
500	215.8	182.3	153.7	135.6	114.3
600	296.0	244.0	208.0	184.3	150.6
700	390.0	319.6	275.9	241.8	202.8
800	479.2	394.1	344.0	308.1	255.8
900	581.0	507.3	434.5	386.6	323.0

Table 2. Insulating Performance of 'Rocksil' with Flat Surfaces

Hot-face temp., °F.	Rocksil *thickness*						
	$1\frac{1}{2}$ *in.*	2 *in.*	$2\frac{1}{2}$ *in.*	3 *in.*	4 *in.*	5 *in.*	6 *in.*
200	22.6	17.5	14.8	11.7	9.1	8.8	—
300	45.5	35.2	28.4	23.0	18.2	14.7	—
400	75.0	58.5	47.2	39.0	31.0	24.4	—
500	102.5	79.5	65.4	55.0	38.3	29.0	—
600	135.3	109.1	88.2	73.0	56.5	46.2	39.8
700	178.0	140.4	122.8	101.2	76.2	64.4	50.4
800	214.6	174.5	143.0	121.6	94.6	75.1	62.0
900	273.0	221.0	185.0	157.0	119.0	92.0	82.0

'Stillite'

To satisfy the demand for insulation in different forms, this type of mineral wool is processed into products designed to meet different fundamental needs. While the thermal conductivity of a mineral wool will vary slightly with the form in which it has been produced, typical figures for *Stillite* semi-rigid slabs and felted mineral wool—based on National Physical Laboratory tests—and quoted as B.Th.U./sq.ft./hr./°F./in. thickness, are as follows:

Table 3. Typical Thermal Conductivity Data for 'Stillite' Semi-rigid Slabs

Hot-face temperature, °F.	*Mean temperature, °F.*	*B.Th.U.*
14	27	0.25
75	60	0.23
700	393	0.42
1,000	543	0.46

The foregoing figures show that at elevated temperatures the thermal conductivity does not increase as rapidly as is the case with older insulating materials. Limit of temperature for *Stillite* is about 1,500°F., but in some instances it is in use at higher temperatures. The heat capacity of this mineral wool is 0.18 B.Th.U./cu.ft./°F. temperature difference at 11 lb./cu.ft. density.

Insulation against sound

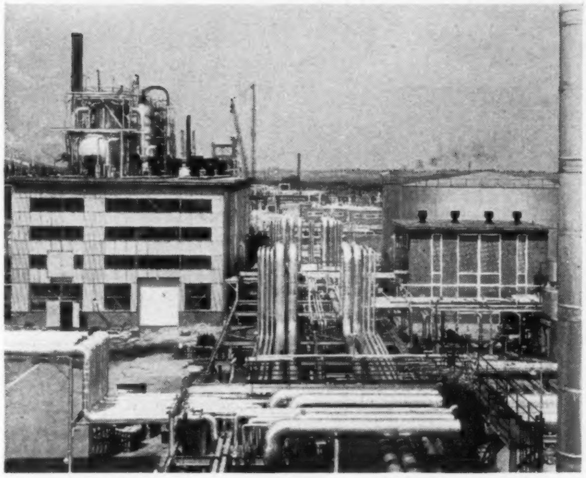
As a sound insulator mineral wool can effect an improvement of impact sound transmission up to 25 phons, and for acoustic insulation and modification has a sound absorption coefficient up to 0.96 at middle frequencies. For sound insulation, lightly felted layers of the mineral fibres are machine-sewn between sheets of waterproof kraft paper, resulting in an insulating quilt of good resilience. When laid below floor boards, or floor screeds of concrete, these quilts act as cushions, isolating impact noises at their source and preventing them from travelling through the structure to adjacent rooms.

In the so-called 'floating floor' construction the quilt is turned up at the edges in order to effect complete discontinuity with the wall frame. For acoustic treatment the mineral-wool fibres may be covered with an envelope of open-mesh cotton scrim cloth, or metal fabric, to enable them to absorb the airborne sound energies. The mineral wool when fixed in this way gives efficient results in reducing the reverberation period of an auditorium or other structure.

When used in building construction, the mineral wool forms part of the

Table 4. Sound Absorption Coefficients for 'Stillite' Slabs and Scrim Mattresses

Frequency (c/s)	125	250	500	1,000	2,000	4,000	6,000	8,000
Absorption coefficient								
1 in.	.20	.45	.80	.85	.85	.95	.85	.95
2 in.	.50	.70	.90	.90	.95	.95	.90	.85



[William Kenyon & Sons Ltd.

Extensive pipe system insulated with 'Rocksil.'

structure and it is generally in inaccessible places. This, however, is normally of no disadvantage, for the material is odourless, hon-hygroscopic, is proof against rot and fungus, and does not attract nor sustain vermin. To a certain extent it may also be regarded as fire-retarding, for it will withstand temperatures up to about 1,500°F. without breaking down, and retains its properties indefinitely.

The figures given in Table 4, based on N.P.L. tests made on *Stillite* semi-rigid slabs 1-in. thick and of 12 lb./cu.ft. density, and scrim mattresses of the same density but 2-in. thick, are typical of mineral wools used for sound deadening and absorption.

Marine work

On board ship much use can be made of mineral-wool insulation in connection with heat losses, refrigeration and sound deadening. The material is specially suitable for such work on account of its light weight, incombustibility and resistance to vermin. Thermal insulation involves covering hot water, steam and exhaust pipes with rigid sections of the mineral wool; boilers and turbine parts may be protected with either quilt or mattress mineral wool; while resin-bonded mineral wool may be employed in covering ventilation ducting, accommodation space, bulkhead casings and also for sound deadening. For the insulation of refrigerated chambers, the mineral wool is packed into cavities and may be covered with sheet metal or boarding. The thickness of wool applied in this way depends on the type of vessel, and heat leakage through the structure is governed mainly by the depth of framing and on the temperature of adjoining spaces. For example, a bulkhead may be common to boiler room and refrigerated chamber, in which case the latter will need a good thickness of insulation.

The projection of steel beams, pipes, etc., into the insulation may have a bad effect on the efficiency of the wool and allowance has to be made for heat losses by conduction along such metal work.

The insulating property of the wool is not improved by pressing it unduly into a confined space. If, for example, a 1-in.-thick mat is compressed to ½-in. thickness, the efficiency of the insulation is reduced. This is because the wool depends for its insulating efficiency upon still air within the fibrous mass.

Mineral wool exhibits a high degree of water shedding, the capillary attraction being about 80% less than for cork, and about 500% less than for some other types of insulation. This capacity to shed water has an important bearing on maintaining the efficiency of the insulation, since water has a relatively high thermal conductivity.

Filtration processes

In the filtration of non-aqueous liquids, vapours and compressed gases, mineral wool of a suitable type provides practically 100% efficiency for solid and liquid particles down to 0.1 micron. With *Stillite* products, maximum efficiency is usually obtained when the gas velocity does not exceed 0.5 ft./sec., but even at velocities up to 2 ft./sec. efficiencies of over 90% are often obtainable. Since the mineral wool is able to withstand high temperatures, a used filter can sometimes be cleaned and renewed by simply burning off the accumulated waste. In other cases, as the wool is relatively cheap, it may be regarded as expendable and discarded after use.

The inert properties of the wool make possible its use in filtering hot gases or vapours without any preliminary cooling. Such filters are being employed in producer gas plants for the elimination of dust particles which would otherwise be carried over to the engines operating on the gas. They are likewise used in the removal of oil from steam where live steam is blown into the product being manufactured, as in some chemical processes. In very sensitive biological processes, penicillin manufacture, etc., the standard of purity is maintained by the use of mineral wool filters.

The chemical industry makes use of cements, the basis of which is mineral wool, and this cement is resistant to most types of chemicals. Tiles for chemical tanks may have a basis of mineral wool, bonded with a chemically-resistant resin.

French Overseas Mining Resources

The Sahara is expected to be one of the richest French overseas territories for mining resources in the near future, according to statistics released by the French Government's Planning Office.

In a review of the progress made in the past few years for the industrialisation of French overseas territories and North Africa, the Planning Office said that the French Government intends to assign some 500,000 million francs to equip and modernise these territories in the next ten years.

The review said the Sahara offers the best prospects for mining resources. In about four years' time 4 million tons p.a. of iron ore will be produced by Fort Gouraud Mines; Akjoujt will produce between 15,000 and 20,000 tons of copper and 1½ million tons of iron ore. The Tindouf mines have reserves of iron ore evaluated at 2,000 million tons.

Big projects are also under study for the improvement of phosphates in Algeria and, in Senegal (French Africa), 500,000 tons/year are expected to be produced when operations are fully under way in about four years' time.

New Trends in Calcium Carbide Manufacture

FRENCH CARBIDE WORKS PREPARE TO MEET INCREASED DEMAND

THE manufacture of calcium carbide is one of the oldest branches of the chemical industry established in the French Alps. The first works were erected more than 50 years ago, and one would think that during such a long time the process of manufacture has reached such a state of perfection that the managers have no other worries than watching a fixed and well-established daily routine.

The chemical engineers who supervise this simple and straightforward process of heating lime and coke in an electric furnace, however, have not allowed themselves to be lulled to sleep by the uniformity of their daily work. On the contrary, they have made great endeavours towards improving the process and, although these improvements often relate to small details, they have helped to increase the yield and have achieved a considerable reduction of the cost price. The developments at the Saint-Gobain works at Modane in the county of Savoy offer a typical example of the inventive spirit of the French technicians.

Reconstruction of carbide works

The works were built in 1925 and, as cheap electricity is essential for the manufacture of carbide, a site above Modane was chosen, which is near the hydroelectric power station of Avrieux. Originally the works did not only make calcium carbide, but also converted part of it into calcium cyanamide. This is a good, but rather expensive, nitrogen fertiliser and has gradually been replaced on the market by the cheaper ammonium sulphate. But other uses have been found for carbide, particularly with the rise of the plastics industry. It has, for instance, become the raw material for the manufacture of polyvinyl chloride.

The Saint-Gobain works were partly destroyed by air attacks in 1943 and, during 1945, Modane was more or less isolated, because all the bridges across the Maurienne had been blown up, but in June 1946 production started again and has grown from year to year. The annual output now amounts to 20,000 tons of carbide, *i.e.*, 10% of the total French production.

Before the war a staff of 180 workers were responsible for a production of 10,000 tons. Today the output is twice this figure, but the number of workers has gone down to 140. This shows more than anything else what has been achieved by modern methods of production.

Automation

Originally the raw materials were shovelled into the furnace. Now the furnaces are fed automatically. Lime and coke are transported by means of conveyor belts to the furnaces, where the correct quantities are weighed on automatic balances, properly mixed and released into the furnace at regular intervals. When one visits this part of the works, one is surprised to find there only a small number of workers, and even those do not actually work but are there in a supervising capacity. Saint-Gobain is not yet a press-button factory, but an important move has been made in this direction.

Seasonal fluctuations

As the manufacture of carbide depends on cheap hydroelectricity being available, it is necessary to make more carbide in summer than in winter. The demand, however, is spread equally over the seasons. Some of the carbide manufactured in summer must therefore be stored for several months, and this is not an easy problem for a product which is as unstable as carbide. It cannot be stored in bulk, but is placed in airtight drums. These drums are stored in colossal warehouses, whence they are withdrawn according to the demand.

Dangerous to transport

Most of the carbide made at Modane is sent to chemical works belonging to the same firm and situated at Saint-Fons near Lyons. At Saint-Fons the carbide is converted into vinyl chloride and derivatives of acetylene. Up to now, 2-cwt. steel drums were used for the transport from Modane to Saint-Fons, but these were awkward to handle, and their resistance against wear and tear was small. Recently, tankers with a capacity of 2 tons have been introduced.

The idea is not new. Similar tankers have been used for a long time to transport all sorts of goods such as cement. But carbide is a different proposition. It contains an enormous amount of energy, which is released immediately it becomes wet. Acetylene is liberated by the action of water on calcium carbide, and mixtures of acetylene and air, even if they contain as little as 3% acetylene, are explosive. To send large quantities of carbide by rail in an absolutely safe way, therefore, is a great problem. It has been solved at Modane in the following way.

The air in the tank is replaced by air which has been treated with silica gel, a highly porous solid which absorbs moisture. This ensures that the content of acetylene in the tank is practically nil, but for greater safety the content of acetylene is controlled by means of an apparatus using infra-red rays.

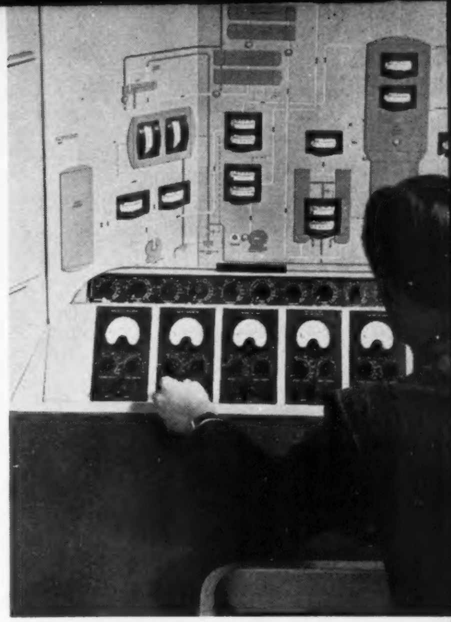
The use of these tanks also offers other advantages. Loading bridges can be used for filling the tanks, and this simplifies the loading operation to a great extent. On arrival the tanks act as hoppers. They can be tilted and discharge the carbide straight into the acetylene generators. The tare weight of these special waggons is small in comparison with the weight of carbide carried, and the cost of transport is considerably reduced. This is an important advantage for a factory which, because of the need for cheap electricity, had to be built far away from the industrial districts of the country.

Future plans

The extent to which calcium carbide may be used industrially in the near future shows still greater possibilities than was anticipated a few years ago, and this is mainly due to its increasing use as a basic raw material for the manufacture of plastics. The Compagnie Saint-Gobain therefore intends to add, in 1958, to the two 6,000-kw. furnaces of the Miguet Perron type a third furnace for 12,000 kw. The new furnace will have a rotating base and will be completely closed. Less gas will be produced, and there will be practically no disagreeable fumes.

MODERN INSTRUMENT PANELS

By Leo Walter



Electronic graphic control desk.

INSTRUMENTATION for the processing of goods can be said to have passed through three distinct phases. Most instruments in the first place were measuring instruments, often only suitable for laboratory use, but they later developed into types for practical application in the factory. The scales of these early instruments were marked in recognised units, which enabled the plant operator and plant engineer or chemist to interpret indications of the measured quantity and to set his control valve or gear accordingly by hand.

The second phase of development can be called the recording phase. It was recognised that most measuring devices for indication of values could also be made to move a recording pen to give a chart record. The latter was irrefutable evidence of what had happened during processing. Recording charts could be analysed and then filed, to be consulted later in case something had gone wrong.

Thirdly, an originating movement of either an indicating or recording instrument was used to exercise a form of automatic control, thus making processing independent of the continuous attention of the plant operator. Automatic control devices have been developed which are power-operated by means of compressed air, or water under pressure, or by electric current.

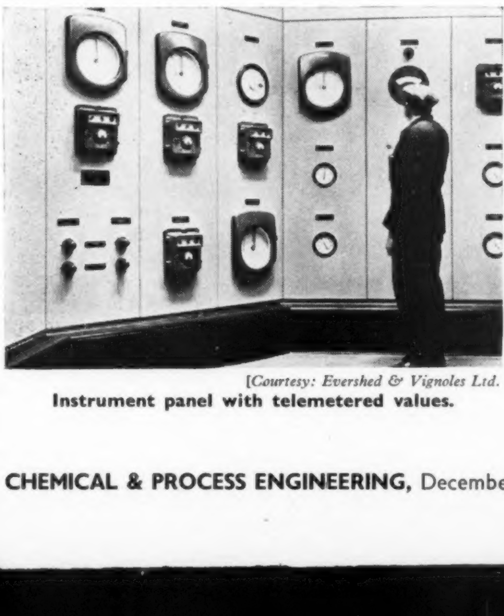
Automatic control systems

Each automatic control system consists essentially of (*a*) a detecting element, sending out control impulses; (*b*) a control mechanism, consisting of a measuring section and a control section; (*c*) a magnifying element or amplifying relay which often has to be used, either to increase small measuring impulses, or to transform small control movements within the control section of a controller mechanism into forceful control impulses; and (*d*) the latter then activating a regulating unit, which can be a control valve, a damper, or a piston motor moving another control device. These control elements are grouped in the 'control cycle' or 'closed loop.' Each disturbance of a controlled process factor or 'variable' thus starts a chain of actions and reactions, of which the controlled variable is an essential link.

Initially, the simplest mode of control was the 'two-step' mode, which can be 'on-off' or 'high-low.' Then came the 'multi-step' mode, which in its simplest form is 'three-step' or 'high-medium-low' but can have a multitude of steps or valve positions. This leads to 'gradual' or 'metering' or 'modulating' modes of control, ranging from the simple 'proportional' mode to 'integral' or reset mode, and ultimately to 'second derivative' or 'rate' control.

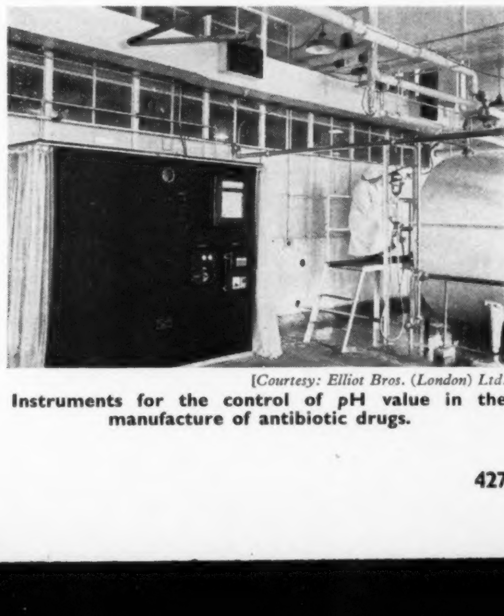
'Telemetering' developments

A great step towards progress in instrumentation of chemical plants was the introduction of 'telemetering' or remote measurement. A non-indicating, or indicating, or recording 'sender' was pneumatically or electrically



[*Courtesy: Evershed & Vignoles Ltd.*

Instrument panel with telemetered values.



[*Courtesy: Elliot Bros. (London) Ltd.*

Instruments for the control of pH value in the manufacture of antibiotic drugs.

connected to a second remotely located 'receiver,' thus enabling central instrument panels to be used for measurement of often widely dispersed values somewhere in the plant.

The next development in telemetering has been remote measurement and automatic control. An example is today's water distribution system, which demands continuous and accurate measurement of water pressure, level and rate of flow because of the varying and often heavy loads. In a typical instance, three pumps provide the main supply, and the sequence of pump operation is secured by a Bristol contact controller of the electrical type. The scheme provides automatic pump control to maintain desired pressure in water systems having no shortage for stabilising pressure. The setting of the neutral zone between the low and high contacts of the L.O.H. (low-off-high) controller determines the pressure differential between starting and stopping of pumps. Cams in the cycle controller are so set that one pump starts before the pump previously in service is stopped. The short time lag is caused by the depresser bar action in the mercury contact controller making the controller insensitive to momentary fluctuations in water pressure.

Central panels

The final result of telemetered automatic control has been very large, centralised control panels, sometimes located in a separate control room. The demand, however, was ultimately for central supervisory instrument panels which took up less space, but at the same time enabled the plant supervisor to see at a glance the actual state of any measured and controlled value on a graphic flow sheet on the central panel.

The urgent demand came first from the oil industry, where new processes, such as catalytic cracking units, made central instrument panels using conventional instruments too big and difficult to supervise. When, originally, measuring instruments were alone, they were of necessity located near the points of measurement and control within the plant, but, as the latter became more complex and the number of instruments to centralise became greater, the best concentration of supervisory duties suggested telemetering of measurement and of control on graphic panels, providing the plant operator with a picture of the plant in front of him. He could thus conveniently associate the different controllers with their various functions.

Centralised control needs of petroleum and chemical processes

The engineers and chemists of oil refineries, who initiated the demand for graphic panels and control desks, reasoned as follows. The supervising operator of a plant under fully automatic control needs to have primarily indications of measured quantities in relation to set points for control in front of him. At the same time, means must be provided to change over from automatic to manual control if necessary; for example, for starting up. The man in front of the control supervisory instrument panel also wants indications of some of the controlled process variables in front of him to give a complete picture of the plant. All these primary essential instruments have to be supported by secondary instruments, not necessary for actual plant operation, but vital for recording purposes.

Thirdly, indications of such values as supply pressure, level or rate or flow of materials should be available for occasional checking purposes.

The problems of the various designers of graphic panels have therefore been: (*a*) to develop miniature instruments for remote measurement and control; (*b*) to insert them into a graphic flowsheet of the process; and (*c*) to group all secondary instruments, especially recorders, within easy reach.

Graphic or mimic or supervisory instrument panels can be used for centralised control, *i.e.* from one central point instead of leaving the controls dispersed in the plant. Long distances between a detecting unit (primary element) somewhere in the plant and an instrument on the control panel, however, made it often difficult to adjust a controller quickly to changed conditions. This has increased the demand for complete 'robotisation' where a supervising engineer has, at a central panel or desk in front of him: (*a*) a flow diagram of the controlled process; (*b*) small control instruments inserted, enabling readjustments of the set point to be made quickly; and (*c*) indicating or recording instruments for independent checking of control results.

'Signal box' solution

The designers of graphic panels realised that the dimensions of the conventional instrument control panels carrying full-size automatic-control instruments are often so large that, even when they are housed in specially built control rooms and carefully laid out, supervision is a difficult task which may have to be carried out by several operators supervising the same process in its various stages. The problem is not unlike that encountered when it was required to control, from

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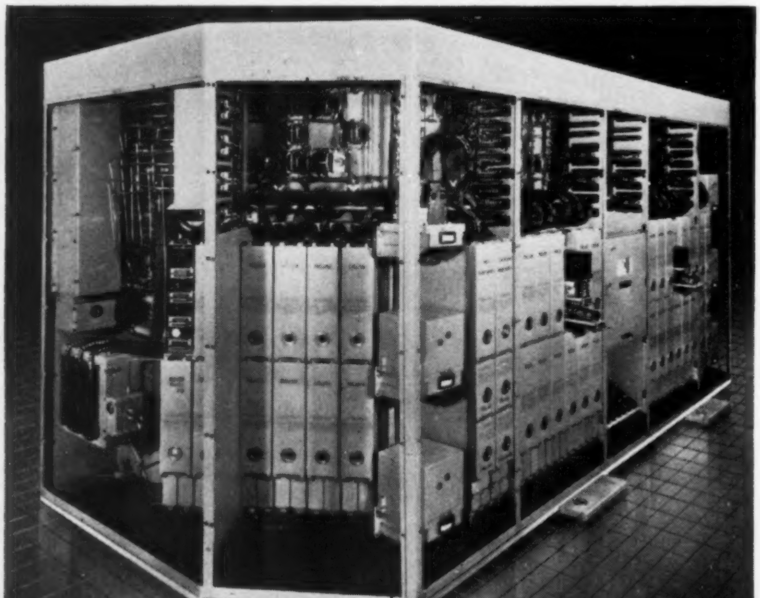


[*Courtesy: Evershed & Vignoles Ltd.*

Back view of electronic graphic control panel.

Advances in Grinding

Crushing and grinding are often large items of cost in chemical processing, owing to insufficient information about the most economical means of operating different types of mills and crushers with various materials. Though chiefly devoted to theoretical aspects of grinding, a symposium which was held by the Institution of Chemical Engineers in London on November 7 also reached some conclusions about grinding in general which should prove of help and interest to users and manufacturers of equipment alike. Our summary includes brief extracts from some of the papers.

Economical milling of fine powders

WHEN extremely fine powders are required, the cost of preparation might be considerable. The great interest of the vibration mill is that it offers a means for the more rapid production of such powders.

The preparation of tungsten carbide, for example, in a ball mill might well involve continuous milling for 200 hr., and this can well reduce the production from a given plant. Only about 60 hours' milling in a vibration mill would be required, however.

Despite this advantage the principles upon which the vibration mill operates have received little study and a paper by Dr. H. E. Rose, University Reader in Mechanical Engineering, King's College, London, sought to analyse the milling process and, with the aid of published experimental results, to reach certain conclusions which are of interest in connection with the choice of the best operating conditions for the milling of a given type of powder.

These conclusions are only tentative, but they offer a useful guide to the influence of the various variables involved. The rate of milling, it was established, varies as a fairly high power of the frequency of vibration and so a considerable increase in milling speed may be obtained by a moderate increase in the frequency of vibration. The rate of milling probably depends upon a lower power of the amplitude of the vibration and for mechanical reasons the amplitude is probably best kept reasonably small.

The amplitude should not be less than about twice the size of the largest particle in the feed material. If this ratio is not maintained, then the initial rate of grinding might be reduced and a product with a size distribution having an excessive quantity of large material is produced.

The rate of grinding varies directly as the density of the ball material and as the diameter of the grinding balls. But it is probably independent of the volume of the ball charge in the mill, provided the ratio of volume of powder to volume of balls is constant and that the balls are not so tightly packed that motion is suppressed. For a given size of mill, however, the production will vary as the volume occupied by the grinding media, provided the above restrictions are observed, and so the largest charge is to be desired.

Differential grinding

There are ores in which the major constituent minerals are limited in number to two or three and the fact that the relative degree to which these minerals are reduced often has an important bearing on the economics and technical results of the subsequent separation process is recognised by some plant operators, who have learnt by experience to adjust their grinding operations to take advantage of differences in reduction rates with benefit to their operation as a whole.

As a preliminary stage in an investigation of such differential grinding, mixtures of quartz and limestone were ground in a batch ball mill under conditions simulating continuous grinding in closed circuit. A paper presented by J. A. Holmes and S. W. F. Patching of the Mineral Dressing Group, Chemical Engineering Division, U.K.A.E.A., A.E.R.E., Harwell, assessed the effects of changes in proportion and mesh of grind on the reduction characteristics of the two components from the results of chemical and screen analyses of the mill feed and products.

To obtain information relative to the problems encountered in ore treatment plants it was desirable to select a method of experiment which would simulate closed circuit conditions. The specific rates of reduction of the components, the size distributions of the feed and products of each component, the characteristics of the circulating loads, and the grindability of the mixtures were considered to be the most important reduction characteristics.

The method adopted was the grindability test of Maxson, Cadena, and Bond, which allows mill dimensions, mill speed, grinding media load, feed size distribution, total percentage circulating load and the method of classification of mill discharge to be kept constant. From a knowledge of the Maxson, Cadena, and Bond grindability over a range of screen apertures, it is possible to make reasonable predictions of the power required to grind the same material on a large scale, *i.e.* test results are translatable to plant practice. Quartz and limestone were selected as two components which would be completely liberated from each other at all sizes.

Among the conclusions drawn from experiments with various mixtures were that the proportion of the two components in the mill has no effect on the ratio of specific rates of grind of the two components. The overall decrease in the specific rates of reduction of the components in the mixtures and their variation with the proportion of components and the mesh of grind can probably be attributed to one or all of the following causes: changes in the packing properties of the mill contents; changes in the grinding action in the mill due to changes of the coefficients of friction between the surfaces in the mill; mutual interference between quartz and limestone particles in the crushing zone, or, differences in the sub-sieve size distribution of the products from the mill.

Simple equations were developed defining the circulating load of each of two components in terms of the total circulating load, the ratio of the specific rates of reduction of the components, the ratio of their densities and their proportion in the feed.

Comminution theory

In ore treatment processes, which are perhaps more intimately concerned with all aspects of comminution than any other branch of technology, crushing and grinding is frequently the major item of cost. The consequent economic pressure has prompted many workers to investigate the underlying theory of comminution of inhomo-

geneous brittle material in the hope that empiricism in the choice and method of operation of equipment can be reduced.

Comminution theory is concerned with the relation between the cause and effect of particle size reduction, the cause represented by the energy expended and the effect by the reduction in particle size achieved. The ultimate aim of any useful study of this relation is normally to improve the overall efficiency of any size reduction operation and so to improve the economy of the process with which the operation is associated.

With this aim in view a further paper by Mr. J. A. Holmes discussed the problems encountered in the formulation of a theory of comminution and developed a general equation relating energy and particle size based on a suitably modified form of Kick's law.

Investigations are made difficult by the wide variety of behaviour of different materials the size reduction characteristics of which need to be studied. In recent years the tendency has been to approach the problem from the fundamentals of solid state physics, but so far experiments have been limited to a small number of pure materials and the economic value of these investigations has yet to be realised. Even those workers whose immediate object was to effect improvements in the economy of commercial comminution processes have, too frequently, limited their experiments to one or two materials.

The equation in this paper was developed following a study of the wealth of experimental data and theoretical observations on comminution theory available in the literature over the last 90 years. Its limitations are discussed and useful information is given of its application to prediction of power requirements for ball mill grinding in closed circuit, illustrated for a variety of materials. This is based on tests carried out at Harwell on massive crystalline quartz from Par Harbour in Cornwall, a granite from Nigeria, a gold ore from Lake Shore, Canada, and a carboniferous limestone from Derbyshire.

Wear in ball mills

A number of tentative conclusions which will provide useful information for users and manufacturers of ball mills emerged from the theories and laboratory experiments to which another paper by Dr. H. E. Rose was devoted. In particular, with regard to the wear on the surface of balls, he concluded that this function reaches a maximum when approximately one-tenth of the space between the balls is filled, and thereafter decreases rapidly.

The wear of the ball surfaces, it was judged, is a function of the equilibrium number of particles pressed into the surfaces, and this number depends upon the relative hardness of the ball and of the particle. Thus it follows from the treatment that there exists the possibility that, in certain circumstances, soft balls will wear less than hard ones; since soft balls might acquire an artificial 'hard' surface by reason of the hard particles embedded in the surface of the metal.

As was pointed out, this observation is of interest since it is known that one continental manufacturer uses soft iron rods in commercial vibration rod mills. In the discussion which followed, it was stated that there was practical evidence in support of this principle, while Dr. Rose added that in his own research the hard steel balls which had been used showed signs of wear when the silica material ground was still harder.

The fineness of grinding attained by a hard material, in a given time of grinding, increases rapidly as the quantity of powder between the balls is decreased; a maximum being reached when the powder fills approximately one-tenth of the space between the balls. When a soft material is being ground, however, this effect is much less marked and also the maximum is reached when the powder occupies about one-half of the space between the balls.

From the study of the internal dynamics of the ball mill, expressions for the rate of grinding, rate of ball wear, and fineness of the grind in terms of the powder charge in the mill, and for the rate of grinding in terms of milling time, were deduced, and it was also shown that the so-called "Rittinger's law" is an approximate special case of a more general law.

Work with an experimental mill which was constructed to test the theory proved satisfactory, in that it suggested that, at least in certain respects, deductions from the theory were in accord with experimental results.

The ball mill used was about 17.5 cm. diam. and 3.5 cm. long, and this length to diameter ratio differed widely from that found in industrial mills. It was considered, however, on the basis of tests which showed that the motion of the balls was not significantly influenced by the ends of the mill, that the experiments were not invalidated by the small length of the mill.

Application of principle of similarity

Roller mills, jaw crushers, hammer mills, and cone crushers maintain specified efficiency independent of their size, provided the speed of rotation varies inversely as the size of the machine. With edge runner mills and ball mills, a specified efficiency is maintained if the specific gravity of the material from which the rollers or balls are made varies inversely as the size of the mill.

From the results of experiments with apparatus reproducing the effect of different mills and from considerations based on the principle of similarity as applied to the grinding process, Prof. A. H. M. Andreasen of the Royal Danish Technical University, Copenhagen, obtained an expression between the increase of fineness of the material undergoing grinding.

At the end of his paper, Prof. Andreason pointed out that a theory of grinding based upon the premises accepted in this present work could only be an approximation to the process occurring in practice, since exact similarity throughout cannot be realised. In practice the efficiency of the grinding process decreases as the particle size decreases.

From bridges to butadiene plant

A fully illustrated 24-page brochure describes the widespread service in plant construction supplied by Head Wrightson Processes Ltd., 24/26 Baltic Street, London, E.C.1. A brief history of the firm's development since 1840 is given, from its progress up to the end of the 19th century when the company was one of the most prominent bridge builders in the world, through the expansion of the inter-war years, to the beginning in 1940 of the association with the British oil industry for which it is today perhaps best known. The organisation was quick to take advantage of the tremendous opportunity given to engineering by the U.K.'s immense refinery expansion programme of the last ten years and it has designed, engineered and erected plant and equipment for many refineries in Britain and abroad. Its versatility in design and construction is demonstrated by a number of illustrations of equipment by Head Wrightson Processes, ranging from distillation units and a butadiene plant to a modern grease making factory, and including a wide range of ancillary equipment.

Depreciation and Maintenance of Chemical Plant

2—'*Straightline*' *Method of Computation and Accounting*

THE conditions under which specific groups and sections of chemical plant are operated should always be taken into consideration before deciding the method to be applied for the writing down of the book values, and for the purpose of demonstrating the practical application of the 'straightline' method of computation and accounting, a case can be cited in which the evaporation, extraction and distillation plant employed by a British firm was shown in the financial books at a total value of £16,760 as at December 31, 1955. This figure was arrived at after depreciating for a number of years and was made up as follows:

	£
Distilled water evaporators for power and acid evaporators for acid solutions	9,510
Extraction and distillation plant...	7,250

Having regard to the nature and extent of the processes to be undertaken, it was estimated that at the end of another six years the evaporators would have a capital value of about £4,230 and the extraction and distillation plant a value of about £3,000.

Backed by world-wide and sustained service organisations, the firm was encouraged to take advantage of the knowledge and experience of skilled plant engineers, and the annual cost of repairs, renewals, cleaning, overhauling and adjusting the various units was not expected to vary materially as between one financial or working period and another.

New installations planned

The firm had very considerable liquid resources and was in a favourable position to add to its equipment without having to seek any special banking facilities, and at a conference a scheme of development was worked out and approved, based on the prices which were then prevailing and expected to be completed by the end of the current year. This programme was calculated to cost a total of £35,000, of which £13,300 was to be spent on evaporators for the concentration of glue and residual liquors. Additional extraction and distillation plant was also acquired and installed at a total capital cost of £15,000, the net invoiced cost prices of all the new equipment being recorded in the firm's purchases journal and the amounts extended into a 'capital outlay' column, the total of which was transferred to the debit side of a separate asset account opened in the impersonal ledger.

Estimates were then made of the probable service or useful life of the new installations and, in consultation with the suppliers, it was agreed that at the end of ten years these will still have a value of about £7,500. It was also decided to spread the capital cost of the original evaporators over the period on the assumption that they are passed to a subsidiary at £4,230

Asset a/c, Evaporation, Extraction and Distillation Plant

(*Referred to on next page*)

DEBIT		£	CREDIT		£
1956			1956		
Jan.	To balance down ...	16,760	Dec.	By depreciation ...	3,668
Jan.	To additions	28,300	Dec.	By balance down ...	41,392
		£45,060			£45,060
1957			1957		
Jan.	To balance down ...	41,392	Dec.	By depreciation ...	3,668
			Dec.	By balance down ...	37,724
		£41,392			£41,392
1958			1958		
Jan.	To balance down ...	37,724	Dec.	By depreciation ...	3,668
			Dec.	By balance down ...	34,056
		£37,724			£37,724
1959			1959		
Jan.	To balance down ...	34,056	Dec.	By depreciation ...	3,668
			Dec.	By balance down ...	30,388
		£34,056			£34,056
1960			1960		
Jan.	To balance down ...	30,388	Dec.	By depreciation ...	3,668
			Dec.	By balance down ...	26,720
		£30,388			£30,388
1961			1961		
Jan.	To balance down ...	26,720	Dec.	By depreciation ...	3,668
			Dec.	By balance down ...	23,052
		£26,720			£26,720
1962			1962		
Jan.	To balance down ...	23,052	Dec.	By transfer to subsidiary	4,230
			Dec.	By depreciation ...	2,788
			Dec.	By balance down ...	16,034
		£23,052			£23,052
1963			1963		
Jan.	To balance down ...	16,034	Dec.	By depreciation ...	2,788
			Dec.	By balance down ...	13,246
		£16,034			£16,034
1964			1964		
Jan.	To balance down ...	13,246	Dec.	By depreciation ...	2,788
			Dec.	By balance down ...	10,458
		£13,246			£13,246
1965			1965		
Jan.	To balance down ...	10,458	Dec.	By depreciation ...	2,788
			Dec.	By balance down ...	7,670
		£10,458			£10,458
1966					
Jan.	To balance down ...	7,670			

at the end of the sixth year and, in order to be able to incorporate a standard figure for depreciation in the process costings, the annual charge was arrived at in the manner indicated below:

COMPUTATION OF DEPRECIATION

('STRAIGHTLINE' METHOD)

	Depreciation
Original installations	£
One-sixth of £9,530 (*viz.* book values as at December 31, 1955: £16,760; *deduct* estimated value six years hence: £7,230) ...	1,588
New installations	
One-tenth of £20,800 (*viz.* capital cost, January 1956: evaporators £13,300 and extraction and distillation plant £15,000; *deduct* estimated value ten years hence: £7,500)	2,080
Annual depreciation ...	£3,668

The separate schedules are reproduced below:

Year	Amount to be extinguished	Amount written off	Carried forward
Original plant			
	£	£	£
First ...	9,530	1,588	7,942
Second ...	7,942	1,588	6,354
Third ...	6,354	1,588	4,766
Fourth ...	4,766	1,588	3,178
Fifth ...	3,178	1,588	1,590
Sixth ...	1,590	1,588	2
New plant			
First ...	20,800	2,080	18,720
Second ...	18,720	2,080	16,640
Third ...	16,640	2,080	14,560
Fourth ...	14,560	2,080	12,480
Fifth ...	12,480	2,080	10,400
Sixth ...	10,400	2,080	8,320
Seventh...	8,320	2,080	6,240
Eighth ...	6,240	2,080	4,160
Ninth ...	4,160	2,080	2,080
Tenth ...	2,080	2,080	Nil

If no further capital expenditure is incurred under this heading during the period the asset account will show the figures given here (on page 431) at the end of ten years.

It will be noted that, as the figure of depreciation of the original plant was made up of £880 for the evaporators and £708 for the extraction and distillation plant, the former will drop out of the computation at the end of the sixth year, leaving only £708 plus depreciation of the new installations, or a total of £2,788 for each subsequent year. In addition to a systematic allocation and redistribution of their existing plant and equipment, some firms are now drawing up comprehensive schemes for further development and re-equipment, and between one group of chemical engineers and another it is desirable that there should be full and free interchange in order that each undertaking may be operated to the greatest possible economic advantage. While this may or may not operate to the detriment of such sectional interests as debenture stockholders, it can hardly fail to prove beneficial to a group as a whole.

Chemical plant replacement

Items of expenditure incurred in the renewal of chemical plant are sometimes posted direct from the payments side of the user's cash book to the debit side of a general repairs and renewals account kept in a nominal or expenses ledger. Special care is called for, therefore, to ensure that, when the book value of a unit or section of plant is written off, the full cost of replacement is capitalised by means of a posting or transfer to the debit side of the appropriate asset account giving the date of installation and sufficient detail to enable the plant to be readily identified.

Recording chemical plant costs

Certain forms and records applicable to both large and small firms in the industry and also those engaged in the manufacture of chemical plant have now become more or less standardised by practice and recent experience has proved that the economic fulfilment of contracts can be very materially facilitated by the compilation of annual and cumulative summaries of the cost of employing various assets.

When such records take the form of cards they should be of uniform size for housing in a cabinet or drawer where they can be kept in strict alphabetical or numerical sequence by means of a steel rod or other similar device and, in addition to columns for the insertion of the cost of ordinary trade purchases, the user's bought journal should comprise separate sections for the analysis of working costs, capital outlay and other capitalised expenditure.

Working costs can be suitably subdivided to indicate the nature and extent of repairs and adjustments and may be expressed as rates per hour. To enable the total maintenance cost to be ascertained, however, it is often necessary to use subsidiary sheets for recording particulars of the time spent, the requisitions for plant parts and details of all accessories, attachments and gadgets fitted, with the relative issue vouchers. These sheets can be signed by the manager, foreman or charge hand and authentic copies passed to the costing department for entry in weekly abstracts.

Authorisations for the carrying out of repairs to plant are usually given on forms which are made out by the manager or supervisor as and when needed, and copies of these should be passed on to the foremen or fitters to be returned on completion of the jobs. Such specifications need not be very elaborate providing the particulars include a description of the units, the number of the job, the names of the workpeople engaged on the job, the starting and finishing dates or times and the signature of the official authorising the work. The forms or sheets used for the purpose of arriving at the cost of labour expended on each unit of plant should show the number of hours actually worked, with a separate column for calculating the effective rate per hour.

Separate accounts for the various wearing and renewable parts are sometimes kept in the stores ledger, the debit side being used for the recording of the quantities and invoiced cost prices of everything received from outside suppliers or otherwise taken into stock, and the credit side for the insertion of particulars relating to all issues and for the value of any returns outwards. Subject to depreciation, which is usually covered by a percentage added to the figures shown on the credit side of the various accounts, the ledger balances will represent stocks on hand and, while some engineers are able to rely entirely on the accuracy of the inventory and book records, it is advisable to verify some of the figures occasionally.

Maintenance

It is a good plan to divide the maintenance work into the two main classes, one consisting of daily repairs and plant adjustments and the other the large jobs. This is particularly desirable if the total expenditure on the upkeep of the productive equipment is expanding. The repairs of a minor nature will usually be much more numerous and may total a considerable sum, but if the men are able to deal with the jobs right away it may not be necessary to use special authorisations and the entire cost may be charged against the standing orders. On the other hand, the cost of large maintenance work may have to be charged to specific jobs or contracts and, although there is sometimes a lack of co-operation between inspection and personnel, the technique of control and supervision is now a powerful aid in this matter.

Daily check on efficiency

In some sections of the chemical industry the works managers now receive each morning from the various

ACID			
Date ....19.. Time			
From..............Dept. To .... Dept.			
No. of tank	Previous dip	Subsequent dip	Quantity
Received by			
Sent by			

Specimen of transfer card referred to below.

departments reports showing production, present stocks of raw, intermediate and finished materials, the labour position and the state of maintenance and construction, and an examination of this information enables efficiency to be maintained without the need for obtaining supplementary data. From such reports monthly figures can be ascertained by the costing department showing the total cost of operation and also the cost per unit and, while experience has shown that some plant managers are inclined to under-estimate the consumption of raw materials and to over-estimate the production, accurate records can often be ensured by the use of transfer cards, of which a specimen is shown in the accompanying illustration.

The foreman's report sheet relating to acid mixing plant may be divided into sections to include mixed acid production, mixed acid transfer, and the condition of the mixers, the former usually comprising columns for the insertion of the batch number, mixer number, acid used and the total delivered to storage after passing chemical analysis to ensure composition according to required specification.

S. HOWARD WITHEY

British Standards

Rubber laboratory equipment (B.S. 2775: 1956, 3s. net, 'Rubber tubing and bungs for laboratory use'). This new standard was prepared primarily to reduce the variety of sizes of rubber tubing at present being used in laboratories. Only metric sizes have been standardised, as a large proportion of laboratory equipment is now based on metric dimensions. The sizes provided should be adequate for most normal purposes, even where inch dimensions are used.

Water sampling (B.S. 1328: 1956, 6s. net, 'Methods of sampling water used in industry'). A revised edition of an earlier standard, covering requirements for the sampling and physical testing of water used in industry. It deals with the size of the sample, with containers and their labelling, and with the sampling of water of a number of types.

Drawing conventions (B.S. 2774: 1956, 3s. 6d. net, 'Drawing conventions for laboratory glass apparatus'). A standard recommending drawing conventions for representing laboratory apparatus made principally of glass in textbooks and technical journals and reports. The conventions are intended for use both with full-size drawings and with reduced-scale drawings down to about one-tenth full size; the standard is illustrated by 10 pages of examples.

Aminoplastic moulding materials (B.S. 1322: 1956, 5s. net). The standard affects three types of aminoplastic moulding materials: type A (general) including cellulose-filled (former type UX) and wood-filled urea-formaldehyde (former type U) materials. Type M, with improved resistance to hot water, is normally a cellulose-filled melamine-formaldehyde material. There is also type H, with improved electrical properties at high temperature. This includes moulding materials (usually melamine-formaldehyde) with mineral fillers such as asbestos and glass fibre.

A simple statistical technique for control of quality has been adopted. Its use assures the purchaser that no batch will fall below a certain minimum level of quality, and that the average quality of a number of batches will be appreciably higher than this minimum level.

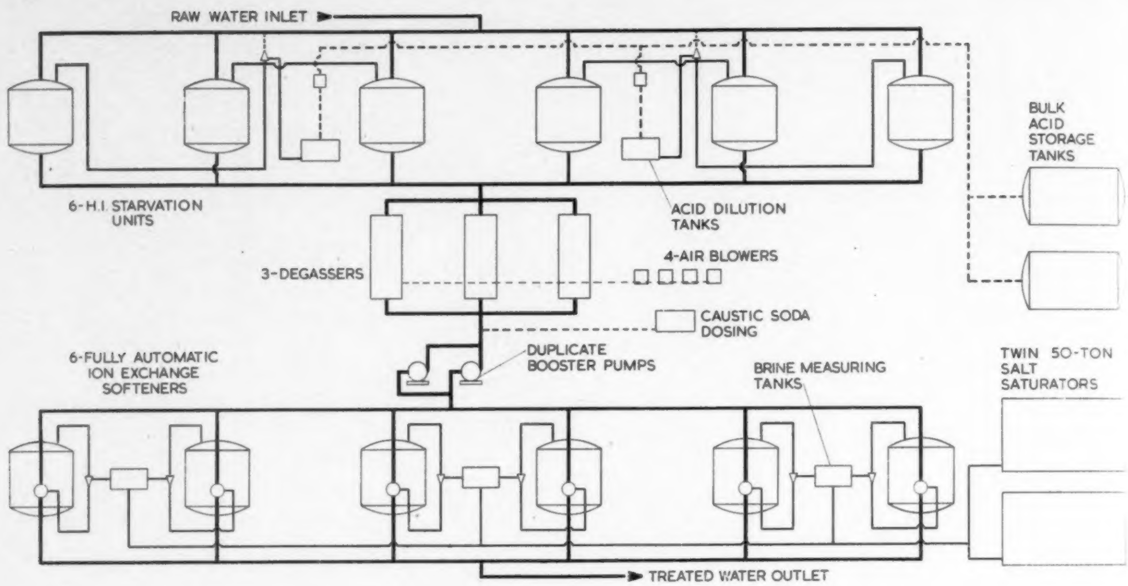
Electricity from atomic power

Calder Hall, described as the foundation stone of the current ten-year programme of nuclear power in the United Kingdom, is the first nuclear power station in the world to generate electricity on an industrial scale. In this book* the whole process of research and planning is described in simple, non-technical language, which succeeds in conveying the reasons which decided the station's final design. Written primarily for the layman, it opens with a resumé of first thoughts about generating power from the atom, preparing the way for the discussion of the problems facing the team of engineers which began work in 1951 at Harwell to see whether these early ideas could be converted into a feasible design.

The 'Pippa' plant which was the subject of their final report and which is now producing power for the national electricity grid at Calder Hall, is described in some detail, not only from the point of view of planning but also with regard to its construction, and a number of photographs taken during the building operations are included. During the first months of 1952 the study of the project had been extended by bringing in engineers from industry, and reference is made to the value of co-operation between the experts of the Atomic Energy Authority and the industrial engineers with their specialised experience.

After bringing the story to a close with a description of the power station on the first day of actual operation, a chapter is added to present more details, for the engineer, of the research involved before building could be begun. The book concludes with a brief assessment of the future of nuclear power production in Britain and of the effective contribution that the Calder Hall station will be able to make.

**Calder Hall*, by Kenneth Jay. Methuen & Co. Ltd., London, 1956. Pp. 88. Illus. 5s.



Ion Exchange in Water Treatment

'Permutit' Installation at Fawley Refinery

The 'Permutit' water treatment plant installed at the Esso refinery, Fawley (Zone 3), includes interesting chemical engineering features.

THE plant supplies zero-softened boiler feed with reduced total solids and controlled alkalinity; the present capacity of the plant is 2,853,000 gal./day and provision has been made to allow the capacity to be increased to 3,958,000 gal./day. The plant includes:

(1) A battery of six *Permutit* H.1 starvation units.
(2) Degassing and caustic soda dosing equipment.
(3) A battery of six *Permutit* fully automatic ion-exchange softener units.

Starvation units

Each unit consists of a closed cylindrical shell containing a bed of special ion-exchange material which contains sulphonyl (SO_3H) and carboxyl (COOH) groups. This material operates on the hydrogen cycle, converting bicarbonates in the raw water to a carbonic acid (that is, to carbon dioxide and water). When the exchange capacity of this material has become exhausted, it is regenerated with dilute sulphuric acid.

Regeneration is completed in three stages. The material is first washed by an upward flow of water, dilute sulphuric acid is then injected and this is followed by a downward rinse in the same direction as normal flow. The whole regeneration cycle for each unit is complete in about an hour and is conducted manually.

Duplicate bulk acid storage tanks are provided for storage of sulphuric acid (BOV) which is subsequently diluted for use in regenerating the starvation units. Acid is drawn from these tanks by means of vacuumatic acid handling systems.

Each vacuumatic system consists essentially of an acid measuring tank; a hydraulically operated vacuum ejector draws acid into a calibrated measuring acid tank. When the vacuum is released the strong acid flows downwards under gravity into the continuous dilution tank where it is mixed with a continuous flow of water and is injected into the appropriate unit by means of a second hydraulic ejector.

Degassing

Carbon dioxide produced in the starvation units is removed by passing the water through three concrete degasser towers operating in parallel.

The water enters the top of the degasser towers and falls downwards over porcelain tower packing rings against the action of an ascending air stream. This effectively scrubs the majority of the carbon dioxide from the water, which is collected in degassed water sumps situated immediately beneath each degasser tower.

Softening and regeneration units

The degassed water is pumped from these sumps to the ion-exchange battery. Caustic soda for *p*H correction is injected on the suction side of the pumps, the rate of injection being controlled by a flow meter fitted in the delivery sideline to the ion-exchange units, which are similar in appearance and construction to the H.I. starvation. They are, however, fully automatic in operation. These units operate on the sodium cycle and are regenerated with brine.

The direction and control of the flow through the units is centralised on each unit by a *Permutit* fully

automatic multiport valve. This valve, working in conjunction with a time clock, directs the various regeneration flow through the unit at the correct intervals of time and returns the unit to service when regeneration is complete.

Regeneration

Regeneration is normally initiated by a contacting head water meter fitted to each unit. This meter closes on electrical control when a pre-set quantity of water has been passed through the unit.

Salt for regeneration of the base exchange units is stored as brine and slurry in two 50-ton salt saturators. The supernatant brine from the saturators flows to three brine measuring tanks, each tank serving three base exchange units, and is injected into the units by hydraulic ejectors similar to those used on the starvation units.

Safe Handling of Gas Cylinders

By H. Allen

THE hazards involved in the use of compressed-gas cylinders appear to be fully appreciated by most managements, but the modern definition of safe working codes means that a precise technique of handling the cylinders must be detailed, for the job analysis and job training of personnel. Listing the minutia of the technique is essential to the establishment of an accident-free code.

Hoses, for instance, need care. Different-coloured hoses are normally used for different gases, and it is wise to stamp the couplings for identification in order to prevent interchange of connections. Operating personnel must be trained to prevent hose from being caught in doors, kinked or run over and from being brought into contact with slag or sparks. It should be axiomatic, too, that all leaking sections of hose be discarded; repair by taping is unsafe. It is dangerous to use a single hose with more than one gas passage, as wall failure would mean that gases mixed in the hose. A flashback in the hose, however brief, will burn the hose and make that section unsafe so that it must be discarded.

Regulators are like tools; they need exact and careful handling. All threads on a regulator should correspond with those on the cylinder valve. Regulators and pressure gauges specifically designed for each gas should be used. If a regulator creeps or builds up pressure on the low-pressure gauge when the torch is closed, the cylinder valve should be closed and the regulator repaired.

Both the use and storage of compressed-gas cylinders demand safety measures. All oxygen cylinders must be kept clear of oil and grease, for, although pure oxygen will not burn by itself, it can cause oil or grease in a gauge or pipeline to explode. There is an inherent explosive hazard with acetylene, too. It should not be generated, distributed or used in pressure greater than 15 p.s.i. Above that figure it becomes unstable and hazardous.

Valves

Acetylene cylinder valves must not be opened more than $1\frac{1}{2}$ turns, and the safe working rule with all liquefied fuel gas cylinders is that they should be stored and used with the valve end up so that the gas and not the liquid comes out. All cylinder valves should be opened slowly. Most cylinders incorporate fusible safety plugs in the valve and some of these are soluble at water boiling point. If valves become clogged, therefore, they should be cleared with warm, not boiling, water and a flame must on no account be used to thaw a valve. It is hardly necessary to say that no molten metal, electric arcs or excessive heat sources of any kind should be allowed to contact compressed-gas cylinders and it is important to protect flammable gases from long exposures to the sun.

Explosive limits

Safety codes covering compressed-gas cylinders should include instruction to personnel in the explosive limits and such data as the following should be assimilated:

Acetylene explosive limits, from 2.5 to 80% by volume in air; ether, 1.8 to 36%; flash point, 49°F.; hydrogen, 4 to 84%; alcohol flash point, 48°F.; acetone, 2.5 to 12.8%; flash point, 0°F.; and so on.

Acetylene should never be generated in an enclosed space. Whenever the gas is being handled, a regulator valve to reduce pressure must be used. Regular and frequent inspection should be made of all cylinders, which must be tested for leaks. All cylinders must be clearly labelled, and tightly secured both in transit and under storage conditions, and the date of the filling marked. Compressed-gas cylinders should on no account be used for any other purpose beyond that for which they were designed and repairs to valves, regulators and attachments should be only done by authorised persons and, if practicable, should be done by the manufacturer.

Storage and mechanical handling

Compressed-gas cylinders should never be stored near gangways, stair wells, elevators or other places where they might be knocked over. Chain or band supports, if necessary, should be provided. No flammable substance such as volatile liquids or oil should be stored anywhere in the near proximity.

Elementary points, these, but they build up into the complete safety code which covers the handling of compressed-gas cylinders. If cylinders are being mechanically handled, lugs should be fitted whenever possible, otherwise cradles should be used. It should be a safety rule never to use chain or rope slings as there is always the risk of the cylinders slipping. In trucking, not only should the cylinders be held securely with clips, but also the wheels of the truck should be rubber tyred so as to reduce the risk of shock being transferred to the pressure gauges. Chocking is essential if the cylinders are being moved by power truck. Off-loading must be done only by trained personnel.

Certain compressed gases have peculiarities which must be respected. Anhydrous ammonia, for instance, a gas which is packed in cylinders in liquid form under pressure to some 100 p.s.i., must be kept below 90°F. because of the high coefficient of expansion of the liquid. Furthermore, the cylinders must be stored away from chlorine and acids.

Acetylene must be kept clear of copper and brass, as they undergo corrosion when in contact with acetylene and form an explosive substance, copper acetylide. Acetylene, ethyl chloride, hydrogen, oxygen and petroleum cylinders can all be connected up to pipelines and reducing valves without breathing apparatus being worn out, but it is necessary to wear such apparatus when handling chlorine, ammonia or phosgene.

All such precautionary measures need to be clearly enunciated and passed on in the form of instructions to operating personnel.

Diphenyl as moderator and coolant in new American atomic reactor

A new type of experimental reactor which is being built in the United States as part of the U.S. Atomic Energy Commission's programme for developing economical atomic power plants which can be used throughout the world, is known as the Organic Moderated Reactor Experiment (OMRE). It is being constructed for the A.E.C. by a private firm, Atomics International, at the National Reactor Testing Station in Idaho, and is expected to be in operation early next year.

The most interesting feature of this reactor is its use of an organic material such as diphenyl, a carbon-hydrogen compound, in the dual role of moderator and coolant. Usually two different materials are used for these purposes.

As a moderator, diphenyl will slow down neutrons produced in the atomic fission process, helping to sustain the chain reaction. As a coolant, the organic material, which will be in a liquid state while the reactor is in operation, will circulate through the reactor core. Here it will 'soak up' heat generated by the fission process and will carry it outside of the reactor to heat exchangers. Potential organic coolants have been investigated for several years in laboratory-scale experiments. The OMRE will permit further testing in an actual reactor.

About 16,000 kw. of power in the form of heat will be produced by the OMRE. Present plans do not call for the conversion of this heat into electricity, since the experimental programme will be concerned only with the technologies associated with the reactor itself. The core for the reactor, where nuclear fission takes place, will consist of plate-type fuel elements containing uranium highly enriched in U-235 and the organic coolant. Heat from the atomic fission process in the reactor core is absorbed by the diphenyl. The hot liquid gives up this heat through heat exchangers. Electric power could then be produced by using conventional steam boilers and generators to convert the heat to electricity. A still purifies the diphenyl for re-use in the reactor system.

Use of an organic compound such as diphenyl offers several advantages which stem from the inherent properties of the material: (1) it has a high hydrogen content which makes it an excellent moderator; (2) it boils at relatively high temperatures compared with water, so there is no need to maintain the compound under high pressures; (3) it causes negligible corrosion with standard materials of construction; (4) it does not react readily with uranium; (5) it becomes only slightly radioactive upon exposure to nuclear radiation.

Problems to be solved are concerned chiefly with the effect of heat and radiation on the organic coolant. They tend to cause the liquid to deteriorate.

The primary purpose of the Organic Moderated Reactor Experiment is to determine the irradiation and thermal stability of organic coolants under conditions that exist in a prototype atomic power reactor.

Modern Instrument Panels

(*Concluded from page* 428)

a main signal box, all the signals and points in a large railway goods yard.

It may not, therefore, be surprising that a solution has been found along the same lines. In the case of the main signal box a central control desk was developed where miniature control gear made it possible to supervise and operate the goods yard with a minimum number of signalmen. The controls are usually superimposed on an illuminated diagram of the goods yard, which further facilitates the task.

In the case of the automatic control room, before a supervisory control desk or panel could be evolved, a simple and universal miniature indicating and controlling instrument had to be developed. Numbers of these instruments could then be located in close proximity to each other and embodied on a supervisory desk or display panel. Where a complicated process had to be controlled, control instruments could be linked by a flow diagram which would illustrate clearly the function of each control in the process.

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To Authors of Technical Articles and Books

The Editor welcomes practical articles and notes on chemical engineering and related subjects with a view to publication. A preliminary synopsis outlining the subject should be sent to The Editor, CHEMICAL & PROCESS ENGINEERING, Stratford House, 9 Eden Street, London, N.W.1.

In addition, the Publishers and Editors of the Leonard Hill Technical Group are always ready to consider technical and scientific manuscripts with a view to publication. Correspondence should be addressed in the first instance to the Book Production Manager, at the above address.

Gas flow through powder

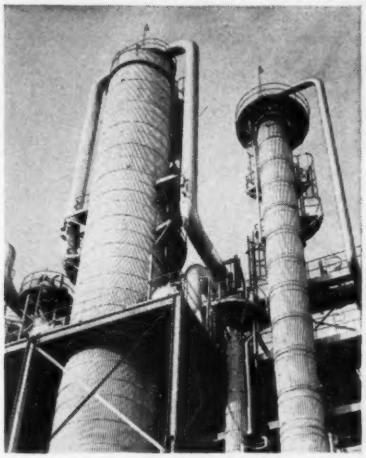
In an experiment related to the flow of gases through a packed bed of silica powder at low pressures, permeation through a bed of fine silica powder at the lower range of pressures, particularly 0-10 microns mercury, was studied, at low flow-rates and ambient temperature.

The results show that the relationship between the specific conductance and gas pressure maintains its linearity to a certain low value, below which further trends are not uniform by any means. The two heavier gases investigated, 'Freon' and air, show increase in specific conductance at zero pressure, while the lighter ones, helium and hydrogen, show the opposite.

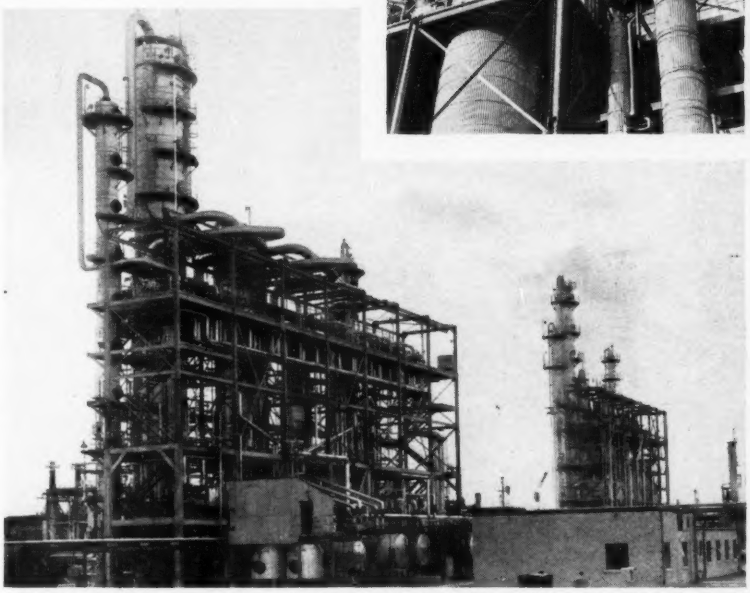
Thus, point out A. G. Monroe and D. I. Gaffu in *Nature*, 1956, **178** (4526), 197, it is apparent that there is present a new mechanism of flow which, so far as the experimental evidence has shown, is related only to molecular weight of the gas and not to its mean free path.

Styrene Monomer A-Plenty

An important addition to the British synthetic rubber programme, the expanded styrene monomer plant at Grangemouth, Scotland, employs a high degree of instrumentation and some of the largest distillation units ever designed and fabricated for the British chemical industry.



NEW facilities which have come into operation at the Grangemouth plant of Forth Chemicals Ltd. have increased the total annual capacity of the plant to over 30,000 tons p.a., and the material is 99.85% pure styrene. Speaking at the official opening, Sir Miles Thomas, D.F.C., chairman of Forth Chemicals and of Monsanto Chemicals Ltd., considered that this production will make it possible for British industry to satisfy all its present needs for styrene monomer without the need for any further imports from the dollar area.



The new distillation area. In the background is the original plant, completed in April 1953. Above is a view of the largest distillation column, which is over 140 ft. high.

Organisation of the new plant

A somewhat complicated tie-up of companies is connected with the plant, Forth Chemicals having been formed in 1950 by British Petroleum Chemicals Ltd. (now British Hydrocarbon Chemicals Ltd.) and Monsanto Chemicals Ltd. British Hydrocarbon Chemicals Ltd. is itself jointly owned by the British Petroleum Co. Ltd. and The Distillers Co. Ltd.

The basic raw materials used for the manufacture of styrene monomer are benzene, derived from coal and delivered in rail tank cars or by road, and ethylene, which is a product of the cracking plant at the nearby refinery of the British Petroleum Co. Ltd. The large quantities of steam, power and cooling water needed in the manufacture of styrene are all available economically by integration of these costly services with British Hydrocarbon Chemicals and the nearby B.P. refinery.

An important material

Styrene monomer first came into prominence as an essential raw material for GR-S synthetic rubber, the United States production of which rose during the war to nearly 800,000 tons/p.a. and required some 200,000 tons/p.a. of styrene. For Britain, indigenous production of styrene for the manufacture of synthetic rubber is of major strategic importance.

Another important outlet, which provided the original reason for the formation of Forth Chemicals, is in the manufacture of polystyrene moulding crystals. The monomer, however, has other important uses, *e.g.* as an intermediate for the manufacture of other essential chemicals—such as dyestuffs, agricultural chemicals and pharmaceutical products—and also in various forms as the basis for many derivatives.

Suitably catalysed mixtures of styrene and certain synthetic resins are readily converted into very tough solids. Reinforced with glass fibre, cloth or paper, such polyester resins produce durable laminates and mouldings. Elastomers made from styrene-butadiene copolymers can be used to reinforce natural rubber, greatly increasing the durability of the finished product.

Even more important to chemical engineers, styrene polymer can be used to manufacture completely insoluble ion-exchange resins, which can increase the capacity of a water-purification system up to ten times and may increase the flow, it is claimed, by as much as 50%. These resins can also be used as refining agents and catalysts in chemical processes. Copolymers of styrene and unsaturated dibasic acids may be used for producing water-soluble polyelectrolytes. These, under suitable conditions, can act as protective colloids and as emulsifying, dispersing and film forming agents. They also have valuable flocculating properties.

In addition, styrene-based emulsion, styrene modified alkyd resins and styrenated oils have found many applications, particularly in paint and enamel manufacture.

The process

The two components, ethylene and benzene, are submitted to an alkylation process, by the Friedel and Craft reaction, using ethyl chloride and aluminium chloride, to give ethyl benzene.

This reaction is exothermic and therefore large heating units can be dispensed with, but owing to the nature of the materials the conditions are highly corrosive. This necessitates the use of glass-lined vessels and special corrosion-resistant alloys. The crude ethyl benzene is distilled and then dehydrogenated by heating with steam in the presence of a catalyst, to give the styrene which is again distilled.

The distillation units have been mounted together for simplicity of operation. They include one column 140 ft. high, which is one of the biggest of its type and which it was found necessary to make water-tight and float to the site.

Automatic control arrangements

An important aspect of the control of the process is the use of instrumentation and automatic equipment. The most recent control room is operated on the semi-graphical system in which all the instruments relating to a particular unit are mounted below the appropriate part of a flow diagram.

The prepared styrene is shipped by road and rail to the consumers, the whole process being closely linked with the activities of British Hydrocarbon Chemicals Ltd., who, since 1948, have built up a series of chemical plants to utilise the materials from the petroleum refinery. With the increasing progress which is being made there the busy and prosperous future of the new plant seems assured.

Contractors

All the design work was carried out by the Monsanto engineering department, which also supervised the construction.

Some suppliers of equipment were: Matthew Hall & Co. Ltd. and Costain-John Brown Ltd. (main contractors); Birwelco Ltd. (hydrogenation plant); Foxboro, Honeywell-Brown Ltd., and Fielden Electronics Ltd. (instrumentation).

RECENT PUBLICATIONS

Flexibles. The first issue of a new quarterly magazine, published by the Compoflex Co. Ltd., 23-25 Northumberland Avenue, London, W.C.2, contains articles on the use of flexible hoses in a chemical factory and on the problems of handling and transporting bulk liquids, as well as a description of the service provided by the new London Flexibles Centre. Some of the problems presented to, and solved by, the advisory service there will be printed in each issue. The contents will also include up-to-date information on the manufacture and use of flexible tubes and hoses, and details, as they become available, of new developments.

Chain, for drag bar conveyors. An illustrated booklet from W. J. Jenkins & Co. Ltd., Retford, Notts, reveals the construction of conveyors for bulk handling of a variety of materials with De Brouwer chain. A capacity nomograph is included for finding the approximate capacity of a conveyor under given conditions.

Plastic tooling. The Marblette Corporation, Long Island City, N.Y., U.S.A., has published an 8-page digest of plastic tooling which concisely summarises existing applications of plastic tooling for metal-forming and plastics-forming and in foundry practice.

Colloid mills. Specifications and general information on construction and application of a range of colloid mills are included in an illustrated leaflet from Moritz Chemical Engineering Co. Ltd., 204 Earls Court Road, London, S.W.5. Super-colloid mills are intended to ensure rapid dispersion combined with shearing and percussion, while in the turbo-colloid mills the effects of percussion and shearing have been combined. The range also includes finishing mills and labo-finishing mills for dealing with products already in an advanced state of fineness.

Corrosion prevention. The harmful effect of chemical attack and abrasion is a major problem common to an extremely wide range of industrial plants. A 16-page booklet just published by Silvertown Rubber Co. Ltd., Herga House, Vincent Square, London, S.W.1, shows how these problems can be overcome by utilising the protective properties of specially compounded rubber and ebonite. The booklet deals with the basic problems arising from the handling of corrosive and abrasive material, and goes on to show how tanks and other vessels, pipes and equipment, are given lasting protection. Reference is made to the lining of vessels 'on site' where the conditions are suitable, and a useful tabulation at the end of the booklet gives details of the chemical resistance of rubber and ebonite to a wide variety of materials and compounds.

Gas equipment. Publication No. 62 of W. C. Holmes & Co. Ltd., Turnbridge, Huddersfield, pictorially surveys the range of products manufactured by this organisation, including, in the gas and chemical engineering division, ammonia washers, benzole recovery plant, condensers and coolers, effluent treatment and gas dehydration plant, etc., with a wide range also represented in the gas handling and gas cleaning divisions.

Pyroclor transformers. Literature on this subject is surveyed in one of the series of laboratory pamphlets published by Monsanto Chemicals Ltd., Victoria Street, London, S.W.1.

Corrosion. An index on corrosion for the ten years 1945-54 has been published by the National Association of Corrosion Engineers, Houston, Texas, U.S. The alphabetical subject index consists of approximately 4,000 reference phrases and alphabetical author index of 1,056 names. Titles are included of 629 articles published between 1945 and 1954. There is a wide variety of subject matter with data on pipeline and petroleum corrosion problems.

Vacuum driers, hot-water circulation units, condensers, receivers and pumps are covered in leaflet DVT-56 issued by Apex Construction Ltd., 15 Soho Square, London, W.1. This includes a description of a range of vacuum tray driers with the drier bodies constructed of welded steel.

Oxygen scavenger. A new 35% hydrazine solution for removing dissolved oxygen from boiler feedwater, *Scav-Ox*, is described in a 16-page illustrated booklet available from the Industrial Chemicals Division of Olin Mathieson Chemical Corporation, Baltimore 3, Maryland, U.S.

Vibration eliminator. A brochure has been published by Compoflex Co. Ltd., 23-25 Northumberland Avenue, London, W.C.2, giving details of a metallic vibration eliminator which they have recently introduced. This device is claimed to be the flexible answer to situations where pipes are misaligned or exposed to movement such as vibration. Various typical applications are suggested for connecting gas, air, oil, steam and water pipes, and a complete description is given of the make up of the eliminator.

WHAT'S NEWS about

★ **Plant**
★ **Equipment**
★ **Materials**
★ **Processes**

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

Laboratory mixer

A new laboratory mixer, fitted with a high-speed turbine-type head, can be used for emulsifying, dispersing, wetting, pigmenting, reacting and dissolving, as well as for conventional mixing and agitating. It is believed that the dispersator is the best type of mixing head for general use, but a marine-type propeller can be supplied for gentle agitation or a small cage-type beater for thicker products.

It can also be supplied either with a small clamp for mounting to the side of a bucket or other mixing vessel or alternatively a pistol-grip handle can be provided where it is necessary for the mixer to be moved from place to place, and can be used for stirring in carboys, barrels, churns, narrow-neck cans, etc. **CPE 420**

Electronic metal detector

The *Cintel* industrial electronic metal detector is a fully automatic inspection device that is claimed to detect the presence of any metal, ferrous or non-ferrous, in any non-metallic material. A maximum of six conveyor lines can be covered with one equipment, with individual control of each line.

The equipment consists essentially of two parts: a search head with amplifier, which is designed to suit the individual manufacturer's product, the width of its aperture being governed by the width of the conveyor belt and its height by the height of the product; and a power unit, whose function is to receive the normal a.c. mains supply and convert this into the appropriate number of d.c. supplies to operate the amplifier units.

The search head comprises a coil system, made up of an oscillator coil and two pick-up coils, suspended in an all-metal casing. The non-metallic section of the conveyor on which the search head is mounted has been reduced to 18 in. on either side, thereby simplifying the problem of installation.

An automatic delay unit has been developed to eliminate the human element involved in the actual removal of the contaminated article once it has been detected. This unit is a mechanical 'memory' system which stores the pulse generated by the alarm relay when metal is detected and releases it some time later when the article containing the metal has travelled along the belt to an ejector. **CPE 421**

PTFE sleeves for ground glass joints

The problem of separating component parts of chemical apparatus has been a very real one for chemists working with materials which are grease solvents (thus making useless the practice of greasing joints) or which form deposits on the joints. When this happens valuable time is lost, apparatus is liable to be broken and the contents lost.

Laboratory mixer.

Sleeves made of PTFE have now been developed as an answer to this problem. The sleeves are truncated cones of PTFE film (about 0.003-in. thick). The taper is accurately 1 in 10 so that the sleeves fit snugly on to their appropriate ground-glass cones.

The waxy surface of PTFE acts as a lubricant and it will not stick, while the sleeves are attacked only by molten alkali metals and fluorine and there are no known solvents. They will withstand temperatures in the range –75 to 250°C. **CPE 422**

Liquid level switch

Developed for the control and indication of liquid level in tanks, boilers, sterilisers and all types of industrial vessels, a new switch designated type WX has no moving parts, yet is capable of switching loads up to 5 amp. at 250 v. a.c. without subsidiary amplifiers or relays, and is particularly suitable for installation where the interior of the vessel being controlled is not readily accessible for cleaning or repairs, since it requires no maintenance whatsoever.

The WX liquid-level switch is a

thermal instrument operating on a difference in heat transfer between the sensitive element and the liquid in the vessel, or the sensitive element and the vapour; not on the difference in temperature or latent heat. This principle gives a very sensitive response, changes of level in the order of ½ in. being sufficient to operate the switch. The operating mechanism is temperature compensated and the instrument is therefore unaffected by temperatures from 0 to 350°F.

It also provides an automatic surge damping effect, since a positive change in level of sufficient duration to affect the heat-transfer rate is necessary before the switch will operate. This entirely eliminates short-cycling caused by momentary changes in level, which is an important advantage in installations normally subject to surging or vibration. **CPE 423**

Heat-resisting alloy steel

A chromium-nickel cast-alloy steel of the 25/12 class is available which is claimed to combine oxidation resistance with superior high-temperature load-carrying ability. This metal has been successfully used in tube supports for oil-cracking units, marine boilers and oil refinery heater units. **CPE 424**

Liquid filtration with porous ceramics

Porous ceramic materials are available as filtration media and are claimed to have resistance to thermal shock and also to corrosive liquids. Other attributes, according to the manufacturers, are high-pore density with uniform permeability throughout the media, providing minute openings for the passage of fluids and gases, together with considerable tensile and compressive strength.

A range of liquid filters, when supplied complete, vary from small glassware vessels of small capacity up to steel containers holding some 200 gal.

Modern industrial reaction processes are carried out at pressures ranging from a few inches of mercury to one atmosphere and a few at still higher pressures. The ceramic elements are variously disposed in the containers and may take the form of a single candle-type element or may be fitted in clusters of up to some 270 units/vessel. **CPE 425**

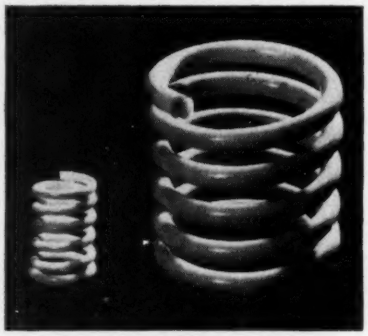
Simpler sealing of plastic packages

A German firm has developed a new heat-impulse sealing instrument for the sealing of plastic packages which has the advantage of direct, automatic temperature control. Thus, no matter whether the instrument is used continuously or intermittently, its operation will be constant. To cater for different plastics it is only necessary to carry out a single readjustment of the single control knob.

The instrument with its various accessories offers wide application. It is of use not only in large packing departments, but also offers the benefits of plastic packing to the smaller firm and retailer. The basic sealing equipment consists of the generator with either tongs or press. The tongs-generator combination is the simplest sealing unit, which not only seals bags up to 7⅞ in. in one operation but is also of great use in larger applications, such as the packing of machinery, where overall sealing is attained by a number of single tong seals end to end. For single seals longer than 7⅞ in., four sizes of foot-operated presses can be supplied up to a maximum length of 47¼ in.

The tongs and presses are designed for either single or double heating, both of which are easily interchanged by the customer. Polyethylene up to 0.0035 in. is sealed with single heating, but up to 0.0059 in. double heating must be used. PVC foils up to 0.0047 in. can be accommodated using double heating.

A number of accessories is available to adapt the instrument to special purposes. **CPE 426**



PTFE-COATED SPRINGS

A process has now been developed whereby springs can be covered with polytetrafluoroethylene.

The coating renders a metal spring impervious to attack by corrosive substances, with the exception of fluorine and the molten alkali metals. Springs so coated will also possess the other characteristics of Fluon *PTFE,* i.e. *they will be solvent resistant, non-sticking, unaffected by moisture and self-lubricating.*

The process is at present limited to certain types of tension spring with simply formed ends and wound with specified pitch requirements, but it is hoped that further experiments will overcome these limitations. **CPE 427**

Open steel flooring and handrailing

New handrail fittings are the latest product of a company which specialises in the production of open steel flooring and handrailing. These *Liongrip* fittings provide a simple means of erecting handrails with the top rail free from obstruction. It is claimed that this design has considerable advantages, reducing erection time and eliminating the use of expensive site equipment.

The feature of the firm's open steel flooring is a strong joint with a double weld forming a box construction. It is made in a diamond pattern, with a metal disc forming the joint and preventing slipping. The joint is sealed against corrosion. Owing to the rigid construction of the flooring, openings in individual panels may be cut at will, without seriously impairing the strength. **CPE 428**

Unit heaters

Installed usually at an average height of 11 ft. well out of the way of machines and traffic lines, *Calorier* unit heaters are designed to direct warm air in a downward flow to floor level and to circulate it throughout a building ensuring uniform warmth, even temperature, and minimum heat loss.

They are claimed to be particularly suitable for factories, garages, workshops and stores and their special applications are drying, steam fog dissipation and heat utilisation from cooling water of diesel engines.

The heaters are stated to be suitable for use on low-pressure hot water or steam. The unit comprises a heater battery, a fan unit and an impeller mounted on the shaft of a totally enclosed motor, enclosed in a casing of stout sheet steel which incorporates adjustable louvres on the discharge side. **CPE 429**

SHOT CLEANING FOR HEAT EXCHANGERS

Originating in Sweden, the shot-cleaning system for heat-exchanger surfaces has revolutionised steam-raising practice in the pulp industry where boilers are fired with sulphate liquor, which leaves a sticky deposit hitherto almost immovable except by manual methods.

Plant now available in Britain is said to eliminate uneconomical dampering back and high power consumption in terms of steam or compressed air, and loss of time entailed in cooling down before manual cleaning can begin.

CPE 430

Atomic reactor lubricant

At Calder Hall atomic power station 60 control mechanisms, which enable the uranium rods to be moved in and out of the reactor, have to be treated and remain lubricated for many years under extremely difficult conditions. Ordinary lubricants are rendered useless by nuclear radiation—sometimes in only a few minutes. Then the atmosphere of dry carbon dioxide in which the mechanisms work also destroys customary lubricants, while atmospheric water vapour is required for graphite lubrication.

A solution was eventually found in a varnish producing a molybdenum disulphide film known as *Molytox*. This was adopted and the control mechanisms are lubricated by dry treatments with this material.

Molytox also protects the control mechanisms from corrosion by carbon dioxide, heat and humidity, and is being used for treating replacement equipment, and for the pre-treatment of control equipment, destined for use in other reactors, to be held in storage.

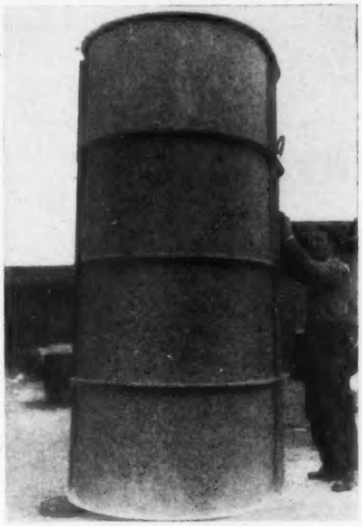
CPE 431

DRUM HANDLING

This lifting and carrying device for drums, boxes, etc., described in our October issue, has a lifting capacity of 800 lb. and can be tipped up and pushed like a wheel-barrow. **CPE 378**

Jute protects steel

Jute hessian treated to protect bright-steel parts against corrosion and rusting is now in commercial production. The impregnated hessian, used as a wrapping for bright-steel strips and bars, is claimed to give full protection under all humid and acidic atmospheric conditions likely to be encountered in transit and storage. It is being supplied in varying widths and on rolls with cardboard centres for reeling off quickly in the wrapping operation. **CPE 432**



CORROSION-RESISTANT TANK

One of the biggest difficulties about lining a tank with protective material is that differential thermal expansion problems between tank and lining are liable to occur. This, say the manufacturers of the 500-gal. sectional tank illustrated, is avoided with their product, since it is entirely made of one material, itself acid resistant.

Glass-fibre-reinforced plastic tanks like this have several other advantages: their damage resistance is very good, there is no easily perforated lining and the risk of tank deterioration is almost non-existent. In installation, site work is usually reduced to a minimum, as the tanks are generally made as one-piece mouldings of relatively low weight.

CPE 433

PROTECTIVE CLOTHING

Designed to give protection against H.T.P. (high-test peroxide) is a light-weight protective suit, for rocket research workers, made with Terylene *coated with PVC. The suit weighs only about 3 lb.* **CPE 434**

Reinforced plastics extrusions

Glass-fibre-reinforced plastics rods, bars, tubes and sheets will be available in commercial quantities shortly from a British firm which has given attention to the installation of specially designed and patented equipment, machinery and processes and to development of new manufacturing techniques.

Rods and bars with diameters ranging from ¼ to 1 in. will be available in continuous lengths, and tubes are to be produced with internal diameters ranging from 1 to 24 in. Any section normally produced as a metal extrusion will also be supplied. **CPE 435**

Welding rectifier

Claimed as an important advance in the field of inert gas-shielded consumable electrode welding, a new constant potential 400-amp. rectifier (C.P.R. 400) for *Argonaut* welding gives optimum self-adjustment of arc conditions and also reduces the possibility of burn back.

Its flat volt/ampere characteristic means that control of the wire feed can be simplified by dispensing with all voltage-sensitive relays, only a current-operated relay (built into the

power source) being employed; the function of this is to start the wire feeding as soon as the arc is established.

A further simplification is that a magnetic amplifier is no longer required for control of current and its omission reduces the cost and bulk of the unit. **CPE 436**

Drying air

Many chemicals, foodstuffs, pharmaceutical products, electrical insulators, confectionery materials and the like are harmed by atmospheric moisture. *Lectrodryers*, it is claimed, hold the relative humidity of a room or storage enclosure at a safe, low level. Dry conditions can be established locally in cubicles, bins, conveyor ducts, or a complete department or building can be dehumidified. Relative humidities down to 10% or lower can be maintained.

The BY 1-type drier is capable of fully automatic operation for all purposes involving the continuous drying of air or gas at pressure. Of the dual adsorber type, actuated by means of a timing cycle device, one cylinder is in operation whilst the other undergoes reactivation.

Typical applications for these automatic *Lectrodryers* include the drying of compressed air for operating instruments and control systems in chemical plant, oil refineries, power stations, etc.; the exclusion of moisture from telephone, radio, radar and other sensitive electrical installations; and the supply of dry air to shot blasting, lacquer spraying, metal spraying and other air-operated engineering plant. **CPE 437**

Automatic boiler control

Instruments concerned with automatic control and units which check that efficient combustion conditions are maintained make up a range of boiler control equipment exhibited recently.

For efficient combustion, the correct air/fuel ratio must be maintained. To determine the amount of air needed, the flue gases are analysed for % CO_2 content which is displayed on an illuminated moving-scale indicator and recorded continuously during operation. The air supply is adjusted for the correct ratio at the outset, and thereafter the recording shows up clearly any failure to maintain it. Similarly, draught must be kept at a minimum consistent with a correct CO_2 reading, otherwise too much heat will be produced and chimney losses increased. This also is adjusted at the outset and is indicated clearly on the panel.

For automatic control, it is necessary to shut down the plant when the required room temperature has been reached, otherwise fuel will be wasted. The plant then remains idle until the temperature falls below a pre-set figure, when it is restarted. This is done by a thermograph with pre-set electrical contacts, which measures the room temperature and brings in or out either of the two boilers as required. Two index thermometers measure the water flow temperatures from the two boilers, and are fitted with cut-out contacts which shut down the plant in the event of failure, which would otherwise cause overheating.

If these instruments were the only means of control, there would still be two important causes of waste. One is that the room temperature would tend to rise too high and fall too low, due to the inertia of the system. The thermograph is therefore adjusted to operate over a small temperature range instead of at a single, set temperature: *e.g.* if the desired temperature were 65°F., the plant might be arranged to switch on when the room temperature had fallen to 64°F., and to switch off when it rose to 66°F.

The other cause of waste is due to changing weather conditions, which vary the amount of heat required to maintain a given temperature within the building. If two boilers were used when one was sufficient, that part of the fuel which goes to heat the unnecessary boiler would be wasted. An index thermometer is incorporated to take care of this. If the outside temperature is very cold, one boiler is left on continuously and, as this would be insufficient to maintain the room temperature, the other boiler is switched on or off by the thermograph. When the outside air temperature rises above a pre-set figure, both boilers are switched on or off together. On a temperate day, however, one boiler alone is sufficient, and the other is automatically shut down by the thermometer. **CPE 438**

Spot welders

The first of a completely redesigned series comprising 40-, 60-, 100- and 150-kva. welders, a 40-kva. air-operated single and repeat spot welder has been introduced. Based on a standardised frame, the major components such as pressure cylinder and lower arm arrangements will be interchangeable.

The 40-kva. welder has a throat depth of 12 to 36 in. and, like all the series, is fitted with a four-function timer controlling squeeze delay, weld-, hold- and off-time. This can be quickly removed as a complete unit for servicing and is fitted with a lock to prevent unauthorised adjustment once a sequence has been set. Primary current control is by an ignition contactor.

Single/repeat spot welder.

The lower arm arrangement allows for versatile entry of components and can be raised or lowered by means of a hydraulic jack.

The foot switch incorporates two pressures—the first to close the electrodes and the second to initiate welds. This feature should be particularly appreciated when spot welding in difficult positions. Restrictors are fitted to cushion the downward thrust in order to prevent hammering. When used for repeat welding, speeds of up to 180 spots/min. are possible. **CPE 439**

Bin vibrators keep materials moving

Bin vibrators are available which have been designed to eliminate the tendency of damp and sticky materials to bridge in hoppers and to clog. In the case of low-angle chutes, it is claimed, delivery will be greatly speeded up by properly applied vibration. The vibrators can also be fitted to tables for consolidating moulds and packages. Standard vibratory control gear is supplied by the same firm and control gear for multiple units is provided to user's requirements. **CPE 440**

Automatic air steriliser

Dust-free sterilised air is available at the flick of a switch with a small cylindrical machine only 3 ft. × 9 in. × 8 in. costing less than £25 and which can be plugged into a domestic light socket.

A fan draws room air into one end of the machine, through special filters, and the irradiation produced within the machine attacks the cell structure of micro-organisms in the air. Air so sterilised is then delivered back into the room from the other end of the machine. **CPE 441**

Polythene tube fittings

Polythene fittings for joining lengths of polythene cold-water tubing have been developed in three nominal sizes for normal gauge tube, enabling tube and fitting to be welded securely together in a quick and simple operation which calls for no manipulation of the tube end.

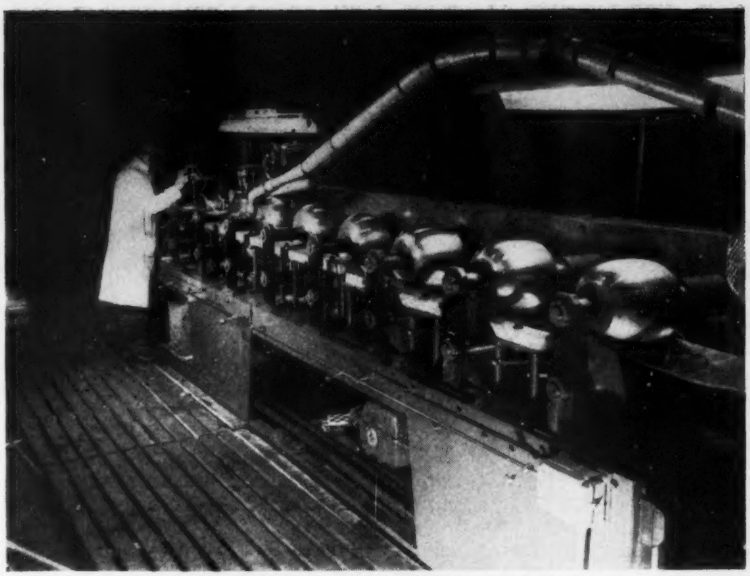
To make a joint with *Alkalite* fittings, the end of the tube is cut square and pushed into the fitting until it butts closely against the shoulder stop inside. Moulded into the fitting are circular resistance elements leading through the fitting body to two external connector wires. Low-voltage current at moderate amperage, passed through the elements *via* the connector wires, produces sufficient heat to cause localised melting of both tube and fitting, welding them together.

A well-charged 6-v. heavy-duty battery, used in conjunction with cable leads of the correct cross-section and resistance for each size of fitting, will provide the necessary current. The welding operation itself takes 15 to 30 sec., and is stopped by breaking the circuit when molten polythene escapes from the point of entry of the connector leads into the fitting. After leaving the joint to cool for a few minutes, the connector wires are snipped off.

The makers claim that the high coefficient expansion of *Alkathene* and the close fit between tube and fitting, combine to ensure a reliable joint. Mechanically, the weld is made at the strongest point, making the joint airtight and watertight and with a tensile strength of the same order as the tube itself. These joints have satisfactorily withstood stringent reversal and fatigue tests.

As an aid to acquiring confidence and proficiency a timing instrument is available which operates on the bimetallic switch principle and is automatic in action. The makers believe that experience will enable the operator to judge the correct welding time accurately from visual inspection of the joint in the making, without the aid of this device. **CPE 443**

Fittings for polythene tube.



WELDED ALUMINIUM PIPING

Welded tubing in aluminium and its alloys is being produced by a British company who have announced a new method overcoming the problems of making tubing in this metal satisfactorily and economically by welding. Welded tubes of up to 4 in. diameter are being made at present. In the new method, illustrated here, the tubing is made from sheet shaped on rollers into the desired cylindrical form and automatically seam welded. It is stated that the surface condition is so good that it is not easy to detect where the weld has taken place. **CPE 442**

YOU SEE THEM COMING

Flexible transparent doors which eliminate all danger of accidents are manufactured from a special tough plastic which can easily be cleaned and is entirely resistant to oils and fats.

The doors are available in sizes up to 8 ft. high × 8 ft. wide and are fitted with double-action tubular hinges. **CPE 444**

Remote-reading resistance thermometers

Remote-reading resistance thermometers are available which are claimed to have an overall accuracy of within $\pm 1°$—according to the meter employed—and a sensitivity of within $\pm 0.1°$C., thus allowing wide ranges of temperature variations to be accurately shown on the 4½-in. uniform scale of the meter.

The thermometers operate on the temperature/resistance change of a platinum sensing element, the small heat capacity of which makes the instrument extremely sensitive to temperature changes, with little time lag. A choice of four models is at present available, covering a range of temperature variations of -50 to 0°C., 0 to 50°C., 50 to 100°C., or 100 to 150°C. Extensions to this range are being considered.

The sensing elements, which can be used at a distance from the instrument, are available in flat form, for attachment to surfaces and for interleaving, or alternatively in the conventional immersion form. The thermometer, with its heavy-duty battery, forms a completely self-contained unit housed within the casing, and accurate thermometer readings are obtained throughout the 400-hr. life of the battery. A strong, compact case encloses the unit, which weighs 12 lb. and measures about 12 in. × 11½ in. × 9½ in.

It is stated that the compactness and other features of this thermometer make it suitable for a wide range of applications from the manufacture of petroleum products and plastics materials to bio-chemistry, baking and brewing.

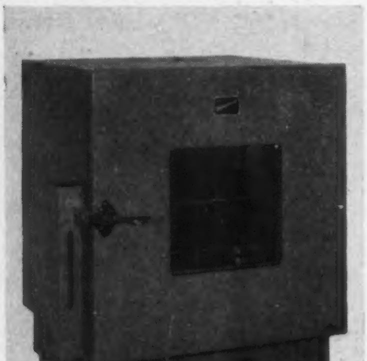
CPE 445

Resin compounds in corrosion-resisting plant

The resistance of the synthetic phenol-formaldehyde resins to many corrosive agents and the favourable properties of synthetic resin compounds have long been recognised, and their use has been suggested in the construction of chemical apparatus. A German firm, which claims to have overcome the technical and economic problems involved by the development of special types of resins, fillers and manufacturing processes, offers a wide range of applications for its compounds.

These compounds are said to possess a high resistance to corrosion, extending to the whole material, and can withstand temperatures of up to 130°C. The products are manufactured in solid, jointless and self-supporting structures; only pieces expected to meet higher mechanical stress are fitted with steel reinforcements. The material has a homogeneous structure and can be machined by the usual methods of turning, grinding, drilling, etc.

Containers of all kinds, towers and columns for reaction, distillation and absorption, reaction vessels and boilers, agitators, pipes, valves, drying racks and carboys are included among the list of applications of these resin compounds. **CPE 447**



HUMIDITY OVEN

This new humidity oven, developed for moderate test conditions, is of 6 cu. ft. capacity and can be used over a temperature range of ambient, or slightly below, to 50°C. **CPE 446**

Electronic fire warnings

Fire-detecting systems are available which react instantly to an abnormal rise of temperature through the medium of fire-detector heads suitably placed throughout a building or industrial site. Each group of up to 16 fire-detector heads is connected to a control unit equipped with signal lamps indicating normal operation as well as warning of fire or faults in the circuit. The warning system may be relayed onwards by means of transmitting and receiving units to one or a number of fire report centres and to the public Fire Brigade through a G.P.O. telephone line.

The detector head consists of two separate windings of tungsten wire and a fusible link, supported on a former made of refractory material. One winding is fully exposed to the atmosphere while the other winding is shielded. The assembled former is rigidly mounted on a steel base, the windings being protected by a metal grille. When a detector head is subjected to a sudden rise of temperature the electric resistance of the exposed wire rises above that of the shielded wire. The resultant reduction in current in the exposed wire unbalances a polarised relay which actuates the fire alarm circuit. The system is self adjusting under average conditions of temperature change. Although the detector is highly sensitive to sudden rises of temperature, it may readily be arranged to meet exceptional conditions. Provision is made in each detector head for a very gradual increase in ambient temperature. This takes the form of an independent fusible spring-link which unbalances the polarised relay at 150°F. or other predetermined temperatures.

The control unit is connected with up to 16 detector heads in series. It contains relays whereby audible and visible signals are automatically registered. The control unit is mounted on a wall together with the power unit and the other equipment in such a position as to be accessible and easily observed yet safe from vibration or physical shock. If it is desired that the visible warnings should be extended to another part of the building, connections may be made from the control unit to an extension indicator which houses a duplicate set of three indicator lamps.

All the fire-detecting systems are designed to operate from a 200 to 250 v. a.c. electricity supply. Their functioning, however, is independent of mains supply failure, since the power unit incorporates a storage battery continuously maintained by a trickle charger. Should the mains a.c. input be interrupted, the cells carry the load of a complete circuit for a period of time dependent on the capacity of the battery and the number of control units being supplied. Under normal operating conditions the system will continue to function for as long as 60 hr. after breakdown of the mains supply. **CPE 448**

AND, IN CASE YOU MISSED THEM . . .

Listed here are the items of plant, equipment, materials, services, etc., described in our 'What's News' feature from January to November inclusive. If you want further information about any of them, just enter the numbers on the reply-paid card provided and post to us.

World News

CANADA

New sulphur plant

The Laurentide Chemical & Sulphur Co. has started construction in eastern Canada of the country's first chemical plant to produce elemental sulphur from petroleum gases, according to press reports. The plant will cost $1.25 million and is to have a production capacity of 33,000 long tons/year.

It is planned to have the works in production by June 1957. The plant will recover sulphur from hydrogen sulphide gases derived from oil refinery gas streams. Gas supply arrangements have been made with five refiners in the area.

The new plant is being privately financed by U.S. and Canadian interests. The sulphur is to be sold largely to pulp and paper mills in the Montreal area and will replace imported supplies now being brought in from the U.S. Gulf Coast area.

SOUTH AFRICA

Water desalting process

The Council for Scientific and Industrial Research in South Africa was asked some time ago to evolve a desalting process, in order to utilise the millions of gallons of brackish water pumped each day out of the Free State gold mines.

Now a pilot plant has been successful at Welkom in the Free State. Recently announcing this success, Dr. S. M. Maude, president of the C.S.I.R., said it had been running 24 hr./day, treating 1,000 gal./hr. and reducing impurities to 1,000 p.p.m. The mines, he said, had now decided to consider the design of a plant to treat 1 million gal./day for use in the recovery of uranium, and so conserve water at present being drawn from the Vaal River.

The cost of the process, it is mentioned, is 2s./1,000 gal., and previously this brackish water from the mines had to be discharged into vast pans on the open veld to evaporate.

BELGIUM

Iranian fertiliser project

A contract has been signed between Union Chimique Belge and the Planning Organisation of the Persian Seven-Year Economic Development Programme for the building of a chemical fertiliser plant using natural gas. The site will be in the Khouzistan province.

NEW ALFA-LAVAL LABORATORY

A view of the engineering testing laboratory which forms a part of the extensive new process laboratories recently opened by Alfa-Laval Co. Ltd. This laboratory is used for large-scale development, particularly on new equipments, including especially washing equipment for machine parts, oil purifying equipment for turbine, diesel and transformer oils, plate heat exchangers for all heat-transfer problems, as well as stainless-steel pumps, oil filters, etc.

CHLORINE EXPANSION

Making a substantial addition to the British heavy chemical industry, a new chlorine and caustic manufacturing installation at the Cheshire works of the Murgatroyd Salt & Chemical Co. uses an advanced German type of mercury cell in the electrolysis of brine. An illustrated article with a full description will appear in CHEMICAL & PROCESS ENGINEERING next month.

CHILE

New chemical factories planned

A factory to manufacture auxiliary products for the textile industry is to be erected by the German chemical firm, Badische Anilin und Soda Fabrik A.G. Imports of machinery worth D.M.43,000 and raw materials worth $U.S.90,000 have been authorised.

The Sociedad Soda Chilena S.A., with a capital of $Ch2,500 million (of which C.O.R.F.O. is to subscribe $Ch1,000 million), is to install a plant for producing sodaic alkali from nitrates in the province of Tarapaca.

SPAIN

Synthetic detergent proposals

The National Institute of Industry has been considering two proposals for the production of synthetic detergents in Spain: one at Puertollano from petroleum products and the other at Palencia from fat alcohol. In each case, the products obtained would be intermediate and the preparation of the detergents carried out by a separate enterprise.

Chemical projects

Two national firms (Union Espanola de Explosivos and Sociedad Iberica del Nitrogeno) have applied for permission to install a factory for the manufacture of nitrogenous fertilisers, superphosphates and other fertilisers at Seville. The companies have asked that the installations should be declared of 'national interest,' thus protecting them against expropriation of land and allowing them exemption from customs duty on imported machinery and a rebate of 50% in taxes.

A new Spanish company to investigate and work the 'espodumena' (lithium) deposits in Lalin (Pontevedra) is to be formed shortly by Titania S.A. (an existing Spanish concern) and the Lithium Corporation of America Inc. The United States' firm

is authorised to supply up to 40% of the capital of the new company, such participation to be in the form of foreign exchange, technical services or machinery.

A new plant for the production of aluminium is to be built in Aviles. Its cost is estimated at 325 million pesetas and it will have an annual production of 15,000 tons of bars, plates and wire. Machinery will be imported, but locally made construction materials will be used.

JAPAN

Polyethylene production

The Furukawa Electric Co., one of the leading Japanese non-ferrous industrial companies, and seven other affiliates of the Furukawa interests have established a new company for producing polythene and polyacryl fibre, at a capital of 300 million yen.

The new company has been named the Furukawa Chemical Industrial Co. It will be supplied by the Nippon Petro-Chemical Co. with raw materials including ethylene for polythene production, and expects to complete a plant by the end of 1957, to start producing polythene at a level of 10,000 tons annually after 1958, with a technical tie-up with the American Standard Oil Co., of Indianapolis.

The Ministry of Trade said a total of seven projects had been approved to start petrochemical production on a commercial basis. Of the seven, six companies are planning to turn out mainly polythene.

Under the present plans, each company will produce an average of 10,000 tons of polythene p.a. in the period between 1957 and 1959. The Ministry of Trade has estimated that the demand for the products for the period will total 35,000 to 40,000 tons p.a.

WESTERN GERMANY

Chemical exports

West German exports of chemical products amounted to 1,820 million marks in the first half of this year, compared with 3,400 million marks for the whole of 1955, according to the Association of the West German Chemical Industry.

The proportion of sales to European countries showed an upward tendency, while exports to other countries declined, chiefly owing to lower sales on African and Asian markets.

Exports to European buyers accounted for 62.6% of all chemical exports in the period under review, compared with 61.5% in 1955.

Holland, which imported 121,600,000 marks' worth of chemical goods from West Germany in the first half of this year, remained the best European customer. Next came France (112 million marks), Britain (104,200,000), Italy (104 million), Belgium (87,700,000), Austria (87 million), Sweden (86,300,000) and Denmark (79,200,000).

Shorter week for chemical workers

The working week for West German chemical factory workers is to be reduced from 49½ hr. to 45 from May 1 next year, it was announced in Hanover, after negotiations between employers and union officials. Talks on a similar agreement for white-collar workers in the industry are also being held.

About 415,000 workers will be affected by the two agreements, bringing the number of West Germans working less than 48 hr./week to about 4.5 million. There are about 18 million workers in the country.

Synthetic rubber project

The synthetic rubber plant now under construction at Hüls in the Ruhr is expected to begin production as originally scheduled in the early summer of 1958. Annual output will amount to 45,000 tons with the production process based on the use of butadiene. Whilst the capital investment necessary is about D.M. 114 million, direct operating costs will be fairly low, as a staff of only 400 workers will be necessary.

Present output of synthetic rubber totals about 12,000 tons; imports in 1955 totalled 19,500 tons, whilst those of natural rubber reached 164,000 tons. Fifty per cent. of the share capital of the new company, Buna-Werke Hüls, is held by Chemische Werke Hüls with the remainder equally divided amongst the three successor concerns to the former I.G. Farben.

Aluminium industry

Consumption of aluminium in the Federal Republic is rising rapidly and dependence on imported supplies has become more marked. Productive capacity is being fully utilised, but completion of the reconstruction of the plant at Grevenbroich will raise it by 12,000 tons to a total of about 150,000 tons.

The State-owned United Aluminium Co., of Bonn, which is responsible for more than 70% of German aluminium production, is considering the building of a new plant. The problem of obtaining adequate supplies of electric power at low cost is the major factor and the choice is likely to fall on the Rhineland area where new generating plants based on its own coal are planned by the electric power producers.

PAKISTAN

Foreign interest in fertiliser factories

Experts from a Japanese firm of machinery consultants have recently inspected sites for the two new fertiliser factories to be set up by the Pakistan Industrial Development Cor-

The Leonard Hill Technical Group—December

Articles appearing in some of our associate journals this month include:

Manufacturing Chemist—Liquid Detergents from Alkyl Benzene Sulphonates; Liquid Nitrogen—A New Grinding Technique; Organotin Compounds Find New Uses; Products Used in the Treatment of Mastitis of the Dairy Cow.

Food Manufacture—Electronically Controlled Coffee Production; Trace Elements in Food; Antibiotics as Food Preservatives—A Survey of the Present Situation in the U.S.A.

Corrosion Technology—Protecting Steelwork from Rust; A New Hot-Dip Galvanising Plant; A Fight Against Ignorance; Basic Studies into the Corrosion Resistance of Aluminium Alloys.

Petroleum—The Influence of the Second Five-Year Plan on the Indian Petroleum Industry; The Search for Oil in Australia; Recent Trends in Oil Geology; Thermal Polymerisation of Ethylene; Infra-red Absorption Analysis in the Petroleum Industry.

Paint Manufacture—The Hiding Power of White Pigments; New Polymerisation Applications of Rosin; Blooming of Varnish Films; Manufacturing Paints for Buildings and Industrial Plants.

Dairy Engineering—Ozone in the Dairy Industry, by D. J. Saxby; The Dairy Industry in Brazil, Part 2, by Prof. J. A. Ribeiro; Report on the Dairy Show; A New Phase-Resistant Starter Medium for Cheese Manufacture; Ice Cream Conference.

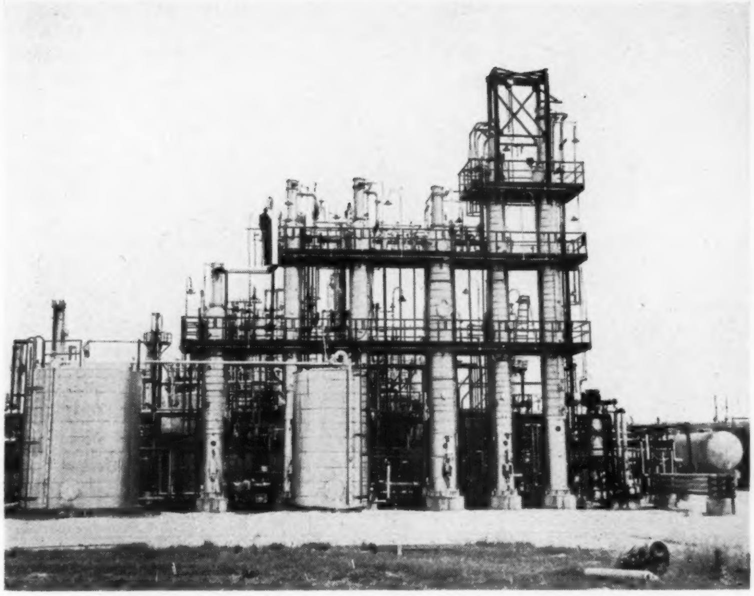
Fibres—Keeping Fabrics Clean; Wool Processing and Technology—The Geelong Laboratory; International Conference on Textile Labelling; The P.3 Ring Frame; Partial Acetylation of Cotton for Heat and Rot Resistance.

Muck Shifter—Rebuilding a Flooded Road (Fleet Bridge); Bridging the Barnhardt Island Channel; Vehicular Tunnel Driven at Mine to Release Additional Ore; Wired Television in Construction Work.

Building Materials—The Largest Bus Repair Works in the World.

Floors—Wood: Its Properties as a Flooring, Part 2.

World Crops—U.S. Department of Agriculture; The Role of the National Institute of Agricultural Engineering; The Work of F.A.O.; Commonwealth Agricultural Bureaux Organisation.



MORE PETROCHEMICALS FROM KENTUCKY

Mono-, di- and triethanolamines are produced from ammonia and ethylene oxide in this new unit at the Brandenburg, Kentucky, plant of Olin Mathieson Chemical Corporation. Ethanolamines are used in the manufacture of detergents and as absorbents in industrial gas-scrubbing operations. Ethylene oxide, ethylene glycol and related chemicals are produced elsewhere in the Brandenburg plant from natural gas obtained from the Tennessee Gas Transmission Co.'s transcontinental pipeline passing through western Kentucky.

poration at Multan in west Pakistan and at Sylhet in east Pakistan.

French, Italian and American firms have been interested in the project.

RHODESIAS AND NYASALAND

Fertiliser factory recommended

At the request of the Federal Government a firm of industrial consultants has reported on the possibility of setting up a nitrogenous fertiliser plant in the Federation. The report is favourable and it recommends the production of ammonium sulphate as the main nitrogen fertiliser.

Consumption of nitrogenous fertiliser has risen from 4,000 tons/year in 1951 to 9,000 tons/year, and it is estimated that the demand may rise to 20,000 tons by 1960 and 40,000 tons by 1970. In 1955 most of the nitrogenous fertiliser used in the Federation was imported from Britain and the Continent at an average landed cost of £24 4s./short ton.

The report estimates the cost of production of ammonium sulphate in the Federation at between £10 15s. 11d. and £15 5s./long ton, according to process and site. Livingstone, Norton and Gatooma were suggested as most likely sites, and the cost of the plant is estimated at up to £5 million or £6 million.

NEW ZEALAND

Fertiliser plans

The contract for the building of a new fertiliser works for the Southland Co-operative Phosphate Co. Ltd., New Zealand, has been let. The works will be large enough to produce 100,000 tons p.a. of superphosphate, and will be of importance to the economic development of Southland as it will make available ready supplies of various types of phosphatic fertiliser for the district's pastures. Almost all the plant will be of British manufacture, some of it being constructed in association with local engineering works.

A start has been made on the £1-million Bay of Plenty fertiliser plant at Mount Maunganui. This works will be one of the largest in the country and construction will take two years, while nearly 300 men will be engaged.

PUERTO RICO

Paper factory

An $8-million factory to manufacture paper and paper products from bagasse will be built at Arecibo, near San Juan. The factory will be built by W. R. Grace & Co., of New York, under the present tax-free industrialisation programme.

GREAT BRITAIN

I.C.I. building new ethylene glycol plant

Imperial Chemical Industries Ltd. are building a second ethylene glycol plant, together with increased ethylene oxide capacity, at their Wilton works in north Yorkshire. It will come into production early in 1959 at the same time as their third olefine plant, from which it will draw its ethylene. The combined capacity of the two ethylene glycol plants will be 16,000 tons p.a. The principal uses of ethylene glycol are for *Terylene* fibre, motor-car anti-freeze and explosives.

New type of medical and safety conference

The prevention and treatment of accidents in chemical factories was one of the main topics of discussion at a two-day conference held by Albright & Wilson Ltd. at their headquarters in Oldbury recently. Doctors, dentists, nursing staff, safety officers and works managers came from the company's factories at Barry, Kirkby, Oldbury, Portishead, Stratford (London), Whitehaven and Widnes. The company believes this to be the first conference of its kind to be held in this country and its main theme was the integration of medical services and management in modern industry.

The guest speaker was Prof. A. C. Frazer, who spoke on 'Food and Disease.' Prof. Frazer has succeeded Sir Frank Engledow as chairman of the British Food Manufacturing Industries Research Association.

UNITED STATES

Chemical modifier for butyl rubber

Monsanto Chemical Co., in co-operation with Esso Research & Engineering Co. (research affiliate of Standard Oil Co., of New Jersey), has developed what is described as the first commercially practical chemical modifier for butyl rubber. The chemical, *Elastopar*, is claimed to double the resilience and strength under strain of unmodified butyl rubber and to do this in the course of conventional processing steps.

The chemical is being produced in semi-commercial quantities and samples are being distributed to the rubber industry for large-scale tests.

Polythene expansion

Based on new construction facilities already under way by the chemical industry, polythene productive capacity in the United States will rise to well over 900 million lb. p.a. by late

1957 from the current level of around 600 million lb. Longer-range estimates are that polythene capacity will be in the vicinity of 1,200 million lb. p.a. before 1960.

Polythene is at present in good supply, with some firms allowing price discounts below listed levels. This is the normal reaction to the large expansion in productive capacity already achieved. However, the average price paid per lb. will rise considerably when many of the new plants come into operation producing high-density polythene. Price outlook for rigid polythene is around 50 cents/lb. at the start of 1957, against 39 cents at present for conventional type, but when the bulk of new plants are operating next year, lower prices are expected.

Methanol expansion plans

The Du Pont Co. is studying the possibility of increasing by approximately 30 million gal. p.a. its production of methanol.

The company is reported to be preparing plans and estimates for a substantial increase in the capacity of its methanol manufacturing facilities at the Sabine River works at Orange, Texas.

Methanol is the raw material for Du Pont's *Zerone* anti-rust freeze, in addition to its many other industrial uses.

Polyol production unit

To meet the increasing demand for trimethylolpropane in the rapidly growing polyurethane plastics and coatings field, Celanese Corporation of America has started construction of a new polyol production unit at its *Chemcel* plant in Bishop, Texas.

The new commercial unit is expected to be completed and producing by the last quarter of 1957. In addition to providing trimethylolpropane and other intermediates for polyurethane synthesis, this new unit will produce a range of other products that will serve end uses in alkyd resins, high-quality brake fluids and other expanding industrial fields.

Anaconda enters ammonia field

Anaconda Co. has signed a contract with U.S. Steel Corporation to purchase anhydrous ammonia from the steel company's $18-million coal chemical plant under construction at its Geneva works near Provo, Utah.

It was announced that the ammonia would be used at the company's Anaconda, Montana, plant for production of ammonium phosphate fertiliser. This is a new product line, and will require a $1-million expansion at the Anaconda works.

U.S. Steels' coal chemical plant will have a yearly capacity of 70,000 tons of anhydrous ammonia. It will be completed by the end of this year.

MALAYA

Polythene pipe production

Hume Industries (Far East) Ltd., manufacturers of steel, concrete and asbestos pipes, have recently begun making polythene piping which will be sold locally under the name of *Aquathene*. It is understood that

COMPANY NEWS

A new Johnson Matthey associate company came into existence recently when the inaugural general meeting of Etablissements Johnson, Matthey et Cie. S.A. took place in Paris. The issued capital is 40 million francs, of which Johnson, Matthey & Co. Ltd. hold 81½%.

The company has been formed to develop Johnson Matthey sales in France. It has taken over the merchanting business of M. Pierre Motton, who has worked in close collaboration with the London company since 1917 when his family became agents for the sale in France of Johnson Matthey products for the ceramic industry. The new company has also absorbed the business of Maurice Carrière et Cie., who acted as correspondents in France for the bullion department of Johnson Matthey.

The offices are in the centre of Paris between the Gare St. Lazare and Place de l'Opera, at 76 Boulevard Haussmann.

*

Birlec Ltd., a member of the A.E.I. Group and well known for the manufacture of industrial furnaces and dehumidification equipment, is about to build Britain's largest and most modern electric furnace manufacturing plant. Announcing a 10-year development plan, the company disclosed that a 34-acre site has been purchased at Aldridge, near Birmingham. By the end of 1966, Birlec expects to have doubled its present number of employees.

*

In December 1953, Mobil Oil Co. set up a European industrial film library for films made in Great Britain, France, Germany and Italy on important industrial subjects. The first three films were made in England and were shown for the first time last October. Now Mobil Oil Co. has announced two new industrial films which were made by its Continental associates entitled 'Hydraulic Systems' and 'Diesel Engine Lubrication.'

*

The Distillers Co. Ltd. announce that British Geon Ltd. has begun the erection of a plant to manufacture special-purpose synthetic rubbers at Barry, Glamorgan.

The new plant will manufacture *Hycar* butadiene/acrylonitrile copolymers and latices usually referred to as nitrile rubbers.

The plant will be located alongside those of British Resin Products Ltd., British Geon Ltd., and Distrene Ltd., the three companies comprising the Distillers' plastics group.

*

Humphreys & Glasgow (Canada) Ltd. has been incorporated as an associate company of Humphreys & Glasgow Ltd., of Humglas House, Carlisle Place, London, S.W.1.

The address of the new company is 837 Eglinton Avenue West, Toronto 10, Ontario, and its activities entail engineering and plant construction for the gas, petroleum, chemical and other process industries.

*

The new and enlarged London Flexibles centre operated by the Flexibles advisory service of the Compoflex Co. Ltd. was officially opened recently at 23-25 Northumberland Avenue, London, W.C.2, by Sir Norman Kipping, director-general of the Federation of British Industries.

*

Q.V.F. Ltd., suppliers of *Visible Flow* glass pipeline for industry, announce that they have acquired new and more extensive premises in Duke Street, Fenton, Stoke-on-Trent. These will replace the firm's existing headquarters in Mill Street, Stone.

The new premises total 60,000 sq.ft. and will initially be used by Q.V.F. for office accommodation, stores, warehouses and for accommodating a new dispatch department and a new technical development section.

A chemical-plant erection department where large glass installations will be assembled for final checking and inspection before dispatch to customers will also be included. It is anticipated that the firm will be established at Fenton towards the end of the year.

materials and technical assistance are being provided by a United Kingdom company. At present the factory is making between 3,000 and 5,000 ft. of the piping per 8-hr. day.

ISRAEL

New chemical factories

The new bromine plant, now reported to be concluding its experimental production run, is expected to produce at 1,250 tons p.a. when full output is reached, it is hoped early in 1957. A total of £I2,200,000 will by then have been invested in the factory. A new building for the production of ethylene dibromide is being erected at the factory.

A small factory for the production of hydrogen peroxide with a planned annual output of 150 tons has begun production at Holon, near Tel Aviv; £I850,000 has been invested in the enterprise. The equipment was purchased from Germany, reportedly at a cost of £I400,000 under the reparations agreement.

FRANCE

Chemical expansion

The chemical company, Bozel-Maletra, has announced that new plant for the following processes has started production at their Petit-Quevilly works:

Cobalt oxide salts are being produced under a new process which will substantially reduce the cost price. Production of sulphuric acid is being stepped up by the operation of two sulphur furnaces in their sulphur roasting works.

Selenium with a high degree of purity is now being extracted from residual pyrites.

Synthetic rubber plant plans

Société du Caoutchouc Butyl (Socabu), which is to produce synthetic rubber at Port Jerome, near Le Havre, has entrusted the American company of C. F. Braun with the building of the plant.

Socabu has been formed by leading French oil, chemical and rubber companies to make France self-sufficient in the field of synthetic rubber.

ITALY

Quicksilver exports

In the first four months of 1956, Italy exported 836.6 metric tons of quicksilver valued at 3,671,847 million lire. Exports included 37.3 metric tons to Czechoslovakia, 107.1 France, 82.1 West Germany, 60 Poland, 61.2 the United Kingdom, 134.9 Japan, 28.4 Canada, 72.4 Colombia and 217.3 metric tons to the U.S.

★ Personal Paragraphs ★

★ Principal executives of Humphreys & Glasgow (Canada) Ltd., the formation of which is reported on another page will be, apart from the board of directors, **Mr. P. de Gray,** vice-president sales, and **Mr. C. T. Hawkes,** vice-president engineering.

★ **Mr. G. E. Godfrey,** M.B.E., has resigned his position with the Dunlop Rubber Co. Ltd. to join the board of Silvertown Rubber Co. Ltd.

★ **Mr. N. S. Stedman,** who has recently joined Mancuna Engineering Ltd., will be responsible for the design work of their new London office. He has spent a lifetime on air-handling work and, in particular, has specialised for many years on de-dusting problems.

★ The Ministry of Supply announces that **Mr. T. D. Jacobs** has been appointed Director of Instrument Production.

★ **Mr. Airey Neave,** D.S.O., O.B.E., M.C., Member of Parliament for Abingdon, Berks., has joined John Thompson Ltd., Wolverhampton, as their legal adviser. Mr. Neave's constituency includes the Harwell Atomic Research Establishment and he has a particular interest in atomic energy. He is a frequent speaker on the subject in the House of Commons. The firm has work in progress for the Atomic Energy Authority's Dounreay fast reactor contract and much research and development work is being carried out in connection with the A.E.I.-John Thompson nuclear power station designs which are being submitted with tenders to the Central Electricity Authority.

★ **Mr. W. Latta,** sales director of Rhodes, Brydon & Youatt Ltd., of Stockport, has flown to South Africa for two months to promote increased sales of the company's wide range of centrifugal pumps, and to appoint agents. He will be visiting Johannesburg, Durban, East London, Port Elizabeth, Cape Town, Bulawayo and Salisbury, returning by sea on January 11, 1957.

★ **Mr. J. S. Roye** has been appointed sales manager of the Chemical and Agricultural Division of Pfizer Ltd., Folkestone. He succeeds **Mr. Ronald Page,** who has resigned to take over an appointment in the United States.

★ **Dr. H. I. Cramer** has been named director, technical liaison, for Pennsalt Chemicals, U.S. In this capacity he will further the company's interest in foreign technological developments and the exchange of scientific information. He is responsible for a number of patents covering accelerators of vulcanisation, antioxidants and processes for high-pressure hydrogenation.

★ **Mr. E. Hartshorne** has been named general manager of the nuclear fuel division of Olin Mathieson Chemical Corporation, United States.

He was formerly executive vice-president and a member of the board of directors of Bradley Container Corporation of Maynard, Mass., formerly a subsidiary of Olin Mathieson. Prior to that he was manager for the research and development department of the film division of the corporation. A graduate of the Massachusetts Institute of Techology, he has been affiliated with Olin since 1934.

★ Each year the Gas Council awards five research scholarships to students who have recently graduated in physics, chemistry or engineering. The scholarships awarded this year are as follows: **Mr. R. Salter** (University of Oxford, Department of Inorganic and Physical Chemistry): Investigation of mechanisms of vibrational activation of hydrocarbon molecules by ultrasonic dispersion measurements on vapours; **Mr. A. Wint** (University of Cambridge, Department of Chemical Engineering): Interfacial transfer phenomena; **Mr. J. W. Arnold** (Imperial College of Science and Technology, University of London, Department of Chemical Engineering): Energy exchange in polyatomic molecules (with particular reference to hydrocarbons); **Mr. P. Owens** (University of Birmingham, Department of Chemical Engineering): High pressure reactions between oil and hydrogen; and **Mr. D. H. Grant** (University of Glasgow, Department of Chemistry): A fundamental chemical investigation within the field of polymer degradation reactions.

★ **Mr. A. Knowles,** manager of the Wembley works of British Oxygen Gases Ltd., has been appointed technical manager, acetylene, at the company's headquarters at Bridgewater House. He takes over the position formerly held by **Mr. E. A. Groom,** who is taking up an appointment with the parent organisation, the British Oxygen Co. Ltd. The new district manager at Wembley is **Mr. D. R. Harris,** formerly assistant production manager at the head office, British Oxygen Gases.

British Patent Claims

Distillation apparatus

A compression still comprising at least one rotary heat exchange and phase separation barrier of high thermal conductivity with radial integral evaporating and condensing surfaces, a feed pipe for supplying distillant inwardly to the evaporating surface, a means for rotating the barrier to maintain the distillant on the evaporating surface in a film thinner than that attainable by gravitational flow, a means for collecting the residue which is centrifugally discharged from the evaporating surface, a means for compressing the vapour and a means for directing the compressed vapour into contact with the condensing surface; the condensate is removed by rotation of the barrier.—757,085, *K. C. D. Hickman* (*U.S.*).

Production of carbon black

In the channel process, a stable aerosol is formed of a normally liquid hydrocarbon and a carrier gas of natural gas or hydrogen (or other combustion-supporting gas of comparable B.Th.U. rating), such aerosol then being conveyed to the carbon black production zone.—757,098, *G. L. Cabot Inc.* (*U.S.*).

Synthetic rubbers

A cured rubber-like material is produced by reacting, under anhydrous conditions, a molar excess of a bifunctional polyisocyanate (*e.g.* an aromatic diisocyanate) with a linear aliphatic polyester (*e.g.* polyethylene glycol adipate) of mol. wt. $\nless$1,000 at elevated temperature in the presence of beryllium hydroxide. — 756,743, *Imperial Chemical Industries Ltd.*

Polymerisation of ethylene

Polymerisation is conducted in a reaction zone having length: width $\nless$15: 1 under a pressure of 1,000 to 2,000 atm. at 110 to 275°C. in the presence of a free-radical-producing catalyst; the temperature/time profile and ratio between the ethylene feed stream and product discharge stream are maintained uniform by introducing a primary stream (to preheat the ethylene to reaction initiation temperature) and secondary streams of an inert liquid with the catalyst at temperatures $<$the effective free-radical-producing temperature. The physical and chemical properties of the polymer at any instant are identical with those at any instant thereafter.—756,813, *E. I. du Pont de Nemours & Co.* (*U.S.*).

Coating polytetrafluoroethylene

Vacuum deposition of a thin, continuous metallic coating (non-fusing at the sintering temperature), from the vapour state, on to unsintered PTFE, the PTFE being sintered under vacuum without fusing or oxidising the coating. The products are used as high-temperature electrical insulators, etc. — 756,814, *Minnesota Mining & Manufacturing Co.* (*U.S.*).

Coating compositions

An aqueous acidic solution containing ferric oxalate (produced by oxidation of Fe^{++} with H_2O_2 or an alkali metal nitrite or chlorate) and F ions is used to give a closely adherent coating on titanium metal; alkali metal or NH_4 ions may also be present in the solution.—756,859, *Imperial Chemical Industries Ltd.*

Cooling device for sinter material, etc.

Annular rotary bins are arranged in vertically stepped relation, and each has a downwardly and outwardly inclined outer wall. A shelf extends from the inner wall and beyond the outer wall, the material being transferred downwardly from shelf to shelf and removed from the bottom shelf by a plough(s).—756,915, *Kaiser Steel Corp.* (*U.S.*).

Rotary suction drum filter

The drum rotates in a vat of liquid, etc., to operate with inward filtration flow, and incorporates cells with outlet ducts bent rearwardly relative to the direction of rotation so as to follow helical lines along the inner walls of the cells and discharge at the end(s) of the drum.—756,763, *Black-Clawson Co.* (*U.S.*).

Refrigerating system

A system (*e.g.* for fractionating a gas mixture); liquid obtained by the aid of a gas refrigerator is raised with the aid of a bubble-up pump, the vapour plugs being produced by heat supplied to the liquid from part of the system of higher temperature than the liquid. —756,895, *N.V. Philips' Gloeilampenfabrieken* (*N*).

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MEETINGS

Institution of Chemical Engineers

January 8. 'Solution of the Equations for Mass-transfer in Plate-type Distillation Columns,' by H. H. Rosenbrock, 5.30 p.m., The Geological Society, Burlington House, London, W.1.

January 15. 'Vacation Training for Chemical Engineers,' by A. J. Carter, 7 p.m., North-Western Branch, The Grosvenor Hotel, Chester.

Society of Chemical Industry

Chemical Engineering Group

January 15. 'The Use of Multiwall Paper Bags in the Chemical Industry,' by A. R. Hutchinson, 5.30 p.m., 14 Belgrave Square, London, S.W.1.

Incorporated Plant Engineers

December 10. 'The Plant Engineer's Approach to Materials Handling,' 7.15 p.m., Glasgow Branch. Joint meeting with the Institute of Materials Handling at the Institution of Engineers and Shipbuilders.

December 12. 'Combustion and Steam Raising,' by D. C. Gunn, 7.15 p.m., Grand Hotel, Bristol.

December 19. 'Plant Planning and Development,' by A. W. Western, 7 p.m., Kings Head Hotel, High Street, Rochester.

January 3. 'Dust Control,' by R. J. Pitt, 7.30 p.m., White Lion Hotel, Church Street, Peterborough.

Institute of Metals

December 11. 'Recent Developments in Aluminium Alloys and their Uses,' by J. C. Bailey, 6.45 p.m., Department of Metallurgy, University College, Singleton Park, Swansea.

Society of Instrument Technology

December 19. 'Instrumentation of Nuclear Reactors,' by T. R. Thompson, 7 p.m., King's College, Stephenson Building, Newcastle.

Institution of Mechanical Engineers

January 4. 'An Experimental Investigation of the Process of Expanding Boiler Tubes,' by J. M. Alexander and Prof. Hugh Ford, 6 p.m., 1 Birdcage Walk, Westminster, London, S.W.1.

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